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RK PLAN

FOR WATERSHED PROTECTION, FLOOD PREVENTION, RECREATION,
AGRICULTURAL and NONAGRICULTURAL WATER MANAGEMENT

EAST FORK OF WHITEWATER RIVER WATERSHED



Darke and Preble Counties, Ohio
Union, Randolph, Wayne, Fayette,
and Franklin Counties, Indiana



OUR SOIL ★ OUR STRENGTH

AD-33 Bookplate
(1-63)

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EAST FORK of WHITEWATER RIVER WATERSHED

Size and Location - 246,000 acres in Darke and Preble Counties, Ohio and Randolph, Wayne, Union, Fayette and Franklin Counties, Indiana.

Sponsors - Wayne, Union, Randolph, Fayette and Franklin Counties Soil and Water Conservation Districts and Whitewater Valley Conservancy District state of Indiana; Darke and Preble County Soil and Water Conservation Districts; Darke and Preble Counties Commissioners; and the Jefferson Township Park District state of Ohio.

Purposes - Watershed Protection, Flood Prevention, Drainage, Municipal Water Supply and Recreation.

Principal Measures - Soil conservation practices on farms and woodlands; and structural measures consisting of one floodwater retarding structure, 5 multiple purpose reservoirs (2 with municipal water supply and 3 with recreation storage and facilities), about 19.6 miles of channel improvement, and 1 channel recreation development. The total storage capacity is 24,589 acre-feet.

<u>Annual Benefits</u> -	<u>Dollars</u>	<u>Percent</u>
To agricultural acreage (land and crops)	19,200	3
To nonagricultural improvements	13,100	2
Indirect	1,800	
Recreation	429,000	71
Municipal Water Supply	70,000	11
Incidental	9,300	2
Secondary	65,300	11
TOTAL	607,700	100

<u>Project Costs</u> -	<u>P.L. 566 Funds</u>		<u>Other Funds</u>		<u>Total</u>
	<u>Dollars</u>	<u>Pct.</u>	<u>Dollars</u>	<u>1/ Pct.</u>	<u>Dollars</u>
Land Treatment	836,000	20	3,319,000	80	4,155,000
Structural Measures					
Flood Prevention	463,000	67	227,000	33	690,000
Drainage	5,000	45	6,000	55	11,000
Recreation	1,263,000	35	2,286,000	65	3,559,000
M&I Water Supply	25,000	20	1,279,000	98	1,304,000
Project Administration	619,000	80	156,000	20	775,000
TOTAL	3,211,000	31	7,283,000	69 2/10	10,494,000

1/ For land treatment measures this is primarily the cost of applying land treatment measures by landowners. Cost-sharing from funds appropriated for the Rural Environmental Assistance Program may be available if included in the county program.

For structural measures this is the cost of land rights and project administration. It may also include costs for construction or engineering services for purposes other than flood prevention.

1/ The value of measures already installed (\$3,001,000) increases this to 76 percent.
Benefit-Cost Ratio - 1.4 to 1
 September 6, 1972

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WATERSHED WORK PLAN

EAST FORK OF WHITEWATER RIVER WATERSHED

WAYNE, UNION, RANDOLPH, FAYETTE AND FRANKLIN COUNTIES, INDIANA
and
DARKE AND PREBLE COUNTIES, OHIO

Prepared Under the Authority of the Watershed
Protection and Flood Prevention Act (Public
Law 566, 83rd Congress, 68 Stat. 666) as
Amended

FEB 3 1975

Prepared By:

WAYNE COUNTY SOIL AND WATER CONSERVATION DISTRICT
UNION COUNTY SOIL AND WATER CONSERVATION DISTRICT
RANDOLPH COUNTY SOIL AND WATER CONSERVATION DISTRICT
FAYETTE COUNTY SOIL AND WATER CONSERVATION DISTRICT
FRANKLIN COUNTY SOIL AND WATER CONSERVATION DISTRICT
WHITEWATER VALLEY CONSERVANCY DISTRICT,

State of Indiana

the

DARKE COUNTY SOIL AND WATER CONSERVATION DISTRICT
PREBLE COUNTY SOIL AND WATER CONSERVATION DISTRICT
DARKE COUNTY COMMISSIONERS
PREBLE COUNTY COMMISSIONERS
JEFFERSON TOWNSHIP PARK DISTRICT,

State of Ohio

Assisted By:

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE
U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE

October, 1971

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PROJECT MAP

WATERSHED WORK PLAN AGREEMENT

Between the

Wayne County Soil and Water Conservation District
Union County Soil and Water Conservation District
Randolph County Soil and Water Conservation District
Fayette County Soil and Water Conservation District
Franklin County Soil and Water Conservation District
and the
Whitewater Valley Conservancy District

State Of Indiana

the

Darke County Soil and Water Conservation District
Preble County Soil and Water Conservation District
Darke County Commissioners
Preble County Commissioners
and the
Jefferson Township Park District

State of Ohio

(Hereinafter referred to as the Sponsoring Local Organizations)

and the

Soil Conservation Service
United States Department of Agriculture
(Hereinafter referred to as the Service)

WHEREAS, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organizations for assistance in preparing a plan for works of improvement for the East Fork of Whitewater River Watershed, States of Indiana and Ohio, under the authority of the Watershed Protection Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666) as amended; and

WHEREAS, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

WHEREAS, there has been developed through the cooperative efforts of the Sponsoring Local Organizations and the Service a mutually satisfactory plan for works of improvement for the East Fork of Whitewater River Watershed, States of Indiana and Ohio, hereinafter referred to as the Watershed Work Plan, which is annexed to and made a part of this agreement;

NOW, therefore, in view of the foregoing considerations, the Sponsoring Local Organizations and the Secretary of Agriculture, through the Service, hereby agree on the Watershed Work Plan and further agree that the works of improvement as set forth in said Plan can be installed in about eight (8) years.

It is mutually agreed that in installing, operating, and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the Watershed Work Plan:

1. Except as otherwise provided herein, the following Sponsoring Local Organizations will acquire without cost to the Federal Government such land rights as will be needed in connection with the works of improvement. (Estimated cost \$1,613,135). The percentage of this cost to be borne by the Sponsoring Local Organizations and the Service are as follows:

<u>Works of Improvement</u>	<u>Whitewater Valley Cons. Dist. (Percent)</u>	<u>Darke County Comm. (Percent)</u>	<u>Jefferson Twp. Park District (Percent)</u>	<u>Service (Percent)</u>	<u>Estimated Cost (Dollars)</u>
Recreation Development No. 35 - Water Re- source Improvement and <u>South</u> Recrea- tion Facilities					
Payment to landowners for about 1100 acres with improvements	50.0	-	-	50.0	579,250
Legal fees, survey costs, flowage ease- ments, and other	100.0	-	-	0	30,450
<u>North</u> Recreation Faci- lities					
Payment to landowners for about 300 acres with improvements	100.0	-	-	0	186,000
Legal fees, survey costs, and other	100.0	-	-	-	11,100
Recreation Development No. 23B					
Payment to landowners for about 440 acres with improvements	50.0	-	-	50.0	103,650
Legal fees, survey costs, flowage ease- ments, and other	100.0	-	-	-	8,205
Recreation Development No. 38					
Payment to landowners for about 125 acres with improvements	-	-	50.0	50.0	65,750
Legal fees, survey costs, and other	-	-	100.0	-	3,340
Channel Recreation Development	100.0	-	-	-	133,750

<u>Works of Improvement</u>	<u>Whitewater Valley Cons. Dist. (percent)</u>	<u>Darke County Comm. (percent)</u>	<u>Jefferson Twp. Park District (percent)</u>	<u>Service (percent)</u>	<u>Estimated Cost (dollars)</u>
All Other Structural measures in Indiana	100.0	-	-	-	433,200
Channel Improvement in Darke County, Ohio	-	100.0	-	-	52,290
Channel Improvement in Preble County, Ohio	-	-	100.0	-	6,150

2. The Sponsoring Local Organization will provide relocation advisory assistance services and make the relocation payments to displaced persons as required by the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. Prior to July 1, 1972, the Sponsoring Local Organization will comply with the real property acquisition policies contained in said Act and Regulations to the extent that they are legally able to do so in accordance with their State law. After July 1, 1972, the real property acquisition policies contained in said Act shall be followed in all cases.

The Service will bear 100 percent of the first \$25,000 of relocation payment costs for any person, business, or farm operation displaced prior to July 1, 1972. Any such costs for a single dislocation in excess of \$25,000 and all costs for relocation payments for persons displaced after July 1, 1972, will be shared by the sponsoring local organization and the Service as follows:

	<u>Sponsoring Local Organization (percent)</u>	<u>Service (percent)</u>	<u>Estimated Relocation Payment Costs (dollars)</u>
Relocation Payments	69.40	30.60	174,650

3. The Sponsoring Local Organizations will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to State law as may be needed in the installation and operation of the works of

improvement.

4. The percentages of construction costs of structural measures to be paid by the following Sponsoring Local Organizations and by the Service are as follows:

<u>Works of Improvement</u>	<u>Whitewater Valley Cons. Dist. (percent)</u>	<u>Darke County Comm. (percent)</u>	<u>Preble County Comm. (percent)</u>	<u>Service (percent)</u>	<u>Estimated Cost (dollars)</u>
Multiple Purpose Structure 4A	89.0	-	-	11.0	449,110
Multiple Purpose Structure 8	88.1	-	-	11.9	455,510
Multiple Purpose Structure 23B	42.1	-	-	57.9	261,820
Rec. Facilities					
Road signs, parking curbs-wheel stops, garbage cans, misc. maintenance equipment	100.0	-	-	-	2,000
All Other Facilities	50.0	-	-	50.0	74,430
<u>Works of Improvement</u>	<u>Whitewater Valley Cons. Dist. (percent)</u>	<u>Darke County Comm. (percent)</u>	<u>Jefferson Twp. Park District (percent)</u>	<u>Service (percent)</u>	<u>Estimated Cost (dollars)</u>
Multiple Purpose Structure 35	50.5	-	-	49.5	393,840
Rec. Facilities					
Road signs, parking curbs-wheel stops, rental boats and oars, life jackets, beach equipment, beach house concession facilities, baskets and racks, garbage cans, washer-dryers, tractor-mower and misc. maintenance equipment, pick-up truck, baseball diamond, basketball court, tennis court	100.0	-	-	-	47,500

<u>Works of Improvement</u>	<u>Whitewater Valley Cons. Dist. (percent)</u>	<u>Darke County Comm. (percent)</u>	<u>Jefferson Twp. Park District (percent)</u>	<u>Service (percent)</u>	<u>Estimated Cost (dollars)</u>
All Other Facilities					
North	100.0	-	-	-	349,430
All Other Facilities-					
South	50.0	-	-	50.0	573,245
Multiple Purpose					
Structure 38	-	-	48.1	51.9	107,420
Rec. Facilities					
Road signs, park- ing curbs-wheel stops, rental boats and oars, life jack- ets, beach equipment, beach house concess- ion facilities, bas- kets and racks, garb- age cans, washer-dryers, tractor-mower and misc. maintenance equipment, pick-up truck	-	-	100.0	-	17,500
All Other Facilities	-	-	50.0	50.0	249,270
			<u>Preble Co. Comm.</u>		
Multiple Purpose Channels					
East Fork - Darke Co.	-	1.1	-	98.9	22,250
East Fork - Preble Co.	-	-	1.1	98.9	43,400
East Fork Lateral 1	-	1.1	-	98.9	34,100
Middle Fork	-	2.2	-	97.8	41,800
Middle Fork, Lateral 1	-	2.2	-	97.8	19,100
Baker Ditch, Darke Co.	-	5.9	-	94.1	11,200
Baker Ditch, Preble Co.	-	-	5.9	94.1	19,800
Baker Ditch, Lateral 1	-	-	5.9	94.1	1,150
Single Purpose					
Structure 28	-	-	-	100.0	46,400
Single Purpose					
Channel Rec. Development	100.0	-	-	-	255,750

5. The percentages of the engineering costs to be borne by the following
Sponsoring Local Organizations and the Service are as follows:

<u>Works of Improvement</u>	<u>Whitewater Valley Cons. Dist. (percent)</u>	<u>Darke County Comm. (percent)</u>	<u>Preble County Comm. (percent)</u>	<u>Service (percent)</u>	<u>Estimated Engr. Costs (dollars)</u>
Multiple Purpose Structure 4A	89.0	-	-	11.0	44,910
Multiple Purpose Structure 8	88.1	-	-	11.9	45,550
Multiple Purpose Structure 23B	-	-	-	100.0	26,180
Rec. Facilities	50.0	-	-	50.0	5,000
Multiple Purpose Structure 35	-	-	-	100.0	36,385
Rec. Facilities- South Baseball diamond, basketball court, tennis court	100.0	-	-	-	1,200
All Other Facilities	50.0	-	-	50.0	40,000
Rec. Facilities- North	100.0	-	-	-	25,000
			<u>Jefferson Twp. Park District</u>		
Multiple Purpose Structure 38	-	-	-	100.0	10,740
Rec. Facilities	-	-	50.0	50.0	17,500
Single Purpose Channel Rec. Development	100.0	-	-	-	23,500
All Other Structural Measures	-	-	-	100.0	23,930

6. The Sponsoring Local Organizations and the Service will each bear the costs of Project Administration which it incurs, estimated to be \$156,330 and \$619,165, respectively.
7. The Wayne, Union, Randolph, Fayette, Franklin, Darke and Preble County Soil and Water Conservation Districts will obtain agreements from owners of not less than 50% of the land above each reservoir and floodwater retarding structure that they will carry out conservation on their land.
8. The Wayne, Union, Randolph, Fayette, Franklin, Darke and Preble County Soil and Water Conservation Districts will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.
9. The Whitewater Valley Conservancy District and the Service will share the installation costs of the Special Land Treatment Measures. Construction costs will be borne 50 percent by the Conservancy District and 50 percent by the Service. Technical assistance will be provided by the Service. The Whitewater Valley Conservancy District will acquire all land rights necessary to assure the installation and maintenance of the Special Land Treatment Measures.
10. The Sponsoring Local Organizations will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed. The Whitewater Valley Conservancy District will be responsible for the operation and maintenance of the special measures installed under the land treatment program.
11. The Whitewater Valley Conservancy District, the Darke County Commissioners, the Preble County Commissioners and the Jefferson Township Park District will be responsible for the operation and maintenance of

the structural works of improvement in their respective areas, by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.

12. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.
13. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

A separate agreement will be entered into between the Service and the Sponsoring Local Organizations before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.
14. The watershed work plan may be amended or revised, and this agreement may be modified or terminated, only by mutual agreement of the parties hereto.
15. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

16. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. 15.1-15.12), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving Federal Financial assistance.
17. The Sponsoring Local Organizations agree that all land acquired or improved with P.L. 566 financial or credit assistance will not be sold or otherwise disposed of for the evaluated life of the project except to a public agency which will continue to maintain and operate the development in accordance with the Operation and Maintenance Agreement.

END OF NUMBERED ITEMS TO AGREEMENT

The signing of this agreement was authorized by a resolution of the governing body of the Wayne County Soil and Water Conservation District,

adopted at a meeting held on _____.

(Secretary, Wayne County Soil and Water Conservation District)

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the Union County Soil and Water Conservation District,

adopted at a meeting held on _____.

(Secretary, Union County Soil and Water Conservation District)

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the Randolph County Soil and Water Conservation District,

adopted at a meeting held on _____.

(Secretary, Randolph County Soil and Water Conservation District)

Date _____

WAYNE COUNTY SOIL AND WATER
CONSERVATION DISTRICT

BY _____

TITLE _____

DATE _____

UNION COUNTY SOIL AND WATER
CONSERVATION DISTRICT

BY _____

TITLE _____

DATE _____

RANDOLPH COUNTY SOIL AND WATER
CONSERVATION DISTRICT

BY _____

TITLE _____

DATE _____

The signing of this agreement was authorized by a resolution of the governing body of the Fayette County Soil and Water Conservation District,

adopted at a meeting held on _____.

(Secretary, Fayette County Soil and Water Conservation District)

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the Franklin County Soil and Water Conservation District,

adopted at a meeting held on _____.

(Secretary, Franklin County Soil and Water Conservation District)

Date _____

The signing of this agreement was authorized by resolution of the governing body of the Whitewater Valley Conservancy District,

adopted at a meeting held on _____.

(Executive Secretary, Whitewater Valley Conservancy District)

Date _____

FAYETTE COUNTY SOIL AND WATER
CONSERVATION DISTRICT

BY _____

TITLE _____

DATE _____

FRANKLIN COUNTY SOIL AND WATER
CONSERVATION DISTRICT

BY _____

TITLE _____

DATE _____

WHITEWATER VALLEY CONSERVANCY
DISTRICT

BY _____

TITLE _____

DATE _____

The signing of this agreement was authorized by a resolution of the governing body of the Darke County Soil and Water Conservation District,

adopted at a meeting held on _____.

(Secretary, Darke County Soil and Water Conservation District)

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the Preble County Soil and Water Conservation District,

adopted at a meeting held on _____.

(Secretary, Preble County Soil and Water Conservation District)

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the Darke County Commissioners,

adopted at a meeting held on _____.

(Secretary, Darke County Commissioners)

Date _____

DARKE COUNTY SOIL AND WATER
CONSERVATION DISTRICT

BY _____

TITLE _____

DATE _____

PREBLE COUNTY SOIL AND WATER
CONSERVATION DISTRICT

BY _____

TITLE _____

DATE _____

DARKE COUNTY COMMISSIONERS

BY _____

TITLE _____

DATE _____

The signing of this agreement was authorized by a resolution of the governing body of the Preble County Commissioners,

adopted at a meeting held on _____.

(Secretary, Preble County Commissioners)

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the Jefferson Township Park District,

adopted at a meeting held on _____.

(Secretary, Jefferson Township Park District)

Date _____

PREBLE COUNTY COMMISSIONERS

BY _____

TITLE _____

DATE _____

JEFFERSON TOWNSHIP PARK
DISTRICT

BY _____

TITLE _____

DATE _____

SOIL CONSERVATION SERVICE
UNITED STATES DEPARTMENT
OF AGRICULTURE

BY _____
(Administrator)

DATE _____

SUMMARY OF THE PLAN

The East Fork of Whitewater River Watershed Project contains approximately 246,900 acres or 386 square miles. The drainage begins in south-western Ohio in Darke and Preble Counties, flowing generally southwest into east-central Indiana through part of the counties of Randolph, Wayne, Union, Fayette and Franklin. The watershed terminus is at the junction with West Fork of Whitewater River at Brookville, Indiana.

The Watershed was originally sponsored in 1961 by the Soil and Water Conservation Districts of Darke and Preble Counties, Ohio, and the Indiana counties of Randolph, Wayne, Union, and Fayette. The application was amended to include Franklin County in 1963. The project gained legal sponsorship for structural measures through the County Commissioners of Darke and Preble Counties, Ohio, in 1969, the Whitewater Valley Conservancy District in Indiana, organized in 1968, and the Jefferson Township Park District in Preble County, Ohio, organized in 1971.

The major problems are: 1) the lack of recreational opportunities in the area; 2) the need for additional municipal and industrial water supply; 3) damages to crops and pasture, other agricultural properties, roads and bridges from flooding of approximately 6,230 bottomland acres; 4) erosion and/or sedimentation damages to floodplains, channels, roads and bridges, and existing reservoirs; 5) joint floodwater and impaired drainage conditions on about 600 acres in upstream channel areas, and 6) deterioration of the quality of the environment.

The total area presently damaged by floodwater and impaired drainage is about 6,830 acres. Population increases, and expanding economy, and more leisure time have led to greater demands for recreation. Existing and planned facilities are inadequate in satisfying this demand. Water needs by the year 2020 will be over four times the present usage for municipal and industrial purposes.

Uncontrolled water runoff has caused destruction of land, loss of valuable topsoil, and deposition of that soil in streams and reservoirs, and on roads and cropland.

There is a real concern among the sponsors that the Whitewater Valley may not be able to meet the needs of the coming generations. They feel this opportunity through PL-566 will provide the needed impetus to make the Whitewater Valley a model for proper use of natural and human resources.

The sponsors propose to solve the existing problems with a combination of land treatment and structural measures. Land treatment conservation plan measures will be installed by individual landowners and operators with technical assistance provided by the Soil Conservation Service, and the Indiana Division of Forestry and Ohio Division of Forestry and Reclamation, in cooperation with the U. S. Forest Service. Cost sharing on construction will be provided by PL-566 for special land treatment measures. Forty-seven small structures will be installed with the cost share assistance to control water, erosion and sedimentation, to provide beneficial on-site water uses, and to enhance the watershed economy and environment. These are discussed under Project Installation and Effects of Works of improvement. The Other cost (all funds other than PL-566) for land treatment measures is estimated to be \$3,318,867, of which \$335,400 is for construction of the special measures and \$267,000 is for Soil Conservation Service and Forest Service technical assistance under the going programs. Public Law 566 cost is \$835,920, of which \$500,520 is for technical assistance for accelerated land treatment installation, and \$335,400 is for construction of the special measures.

Proposed structural measures to meet the sponsors needs are three multiple purpose structures for flood prevention and public recreation with

associated recreation facilities, two multiple purpose structures for flood prevention and municipal and industrial water supply, one single purpose floodwater retarding structure, 10.3 miles of stream corridor development for public recreation, and 19.6 miles of multiple purpose channel improvement for flood prevention and drainage.

The total estimated cost of the proposed structural measures is \$6,339,200, of which \$2,375,508 is PL-566 cost and \$3,963,692 is Other cost. The operation and maintenance of the structural measures will be carried out by the White-water Valley Conservancy District, the Darke County and Preble County Commissioners, and the Jefferson Township Park District for their respective portions of the measures. The total estimated annual operation and maintenance cost is \$90,013, as shown on Table 4 and discussed under Operation and Maintenance.

The installation period for land treatment and structural measures is eight (8) years. The total project cost is estimated to be \$10,493,987, of which \$7,282,559 is from Other funds.

The overall quality of the environment will be enhanced by the proposed measures. Recreation opportunities will be increased with the three reservoir developments and the stream corridor development. The planned recreation developments will complement the proposed activities at Brookville Reservoir. Additional municipal and industrial water supply will be provided to the City of Richmond. Benefits from the proposed project will accrue to the floodplain as damage reduction to crops and pasture, existing water storage reservoirs, and a private channel recreation development. Drainage will be improved as the result of increased channel depth and capacity. Average annual benefits to the project structural measures are estimated to be \$607,622, and are summarized on Tables 5 and 6.

The ratio of average annual benefits of \$607,622 to average annual costs of \$432,584 is 1.4 to 1.0.

DESCRIPTION OF THE WATERSHED

Physical Data

The East Fork of the Whitewater River Watershed consists of a drainage area of approximately 246,900 acres (386 sq. miles). Location of the watershed is in the east-central portion of Indiana in the counties of Randolph (0.9%), Wayne (33.2%), Union (32.3%), Fayette (3.9%), and Franklin (10.5%); and in Western Ohio in the counties of Darke (9.1%) and Preble (10.1%). Of this total drainage area, 379 square miles drains into the Brookville Reservoir (7,790 acres maximum pool area) now under construction by the U. S. Army Corps of Engineers.

The watershed is approximately 46 miles long with an average width of 10 miles, trending in a north-south direction. The major tributaries in the northern portion of the watershed are the Middle Fork and the West Fork. They enter the East Fork of the Whitewater River at Richmond, Indiana, in Wayne County. The Middle Fork Reservoir (175 acres), is located immediately north of the City of Richmond. Other major tributaries include Mud Creek, Little Creek, Lick Creek, Short Creek, Elkhorn Creek, Richland Creek, Silver Creek and Hannas Creek. Whitewater Lake (185 acres), is located on Silver Creek one and a half miles southwest of the town of Liberty, Indiana, in Union County.

There are numerous small farm ponds and several small private lakes and gravel pits in the watersheds. Public recreation is confined to the Middle Fork Reservoir and Whitewater Lake and a few small private fishing lakes and ponds. The Middle Fork Reservoir is the principal water supply source for

the City of Richmond with the remainder of the area being supplied from wells. Aquifers within glacial sand and gravel deposits and limestone beds are the source of ground water supplies.

The northern portion of the watershed lies in the Tipton Till Physiographic Region and southern portion in the Dearborn Upland Region. The watershed area has been influenced by Wisconsin glaciation with a portion of the relief conforming to the bedrock topography. The main local features are glacial uplands, extensive glacial river terraces or outwash plains, and recent alluvial plains. Elevations range from 1,250 feet in the rather flat or slightly undulating uplands to 625 feet near the Town of Brookville, Indiana. The entire length of the floodplain is relative narrow with the maximum width approximately one quarter of a mile. The preglacial valleys are in general shallow in the northern portion and more deeply entrenched in the southern part of the watershed.

The watershed is situated on a major structural feature known as the "Cincinnati Arch." Numerous bedrock outcrops of fossiliferous shales and limestone of upper Ordovician age are present with several overfalls in the main channel and some tributaries. This Ordovician bedrock is the oldest bedrock in Indiana and Ohio and is overlain with Wisconsin glacial deposits ranging in thickness from surface to 200 feet. In the north and east portions of the watershed the Ordovician rocks come in contact with younger rocks of Silurian age. Sand and gravel pits and limestone quarries are located near the City of Richmond and northeast of Middleboro, Indiana, near the Indiana-Ohio State line.

The climate of the watershed is humid and temperate with well distributed rainfall. The average annual rainfall is about 38 inches with an average annual runoff of 12 inches. The high intensity and most damaging

storms occur most frequently during the period April through July, but have occurred at other times during the year. The average annual snowfall is approximately 22 inches. The mean temperature for January is 29.6° F and 73° for July. Mean average annual temperature is 51°. The growing season is approximately 160 days extending from early May to early October.

Soils. There are a total of fifteen soil associations in the watershed. These are indicated on the attached soils map. Following is a discussion of the soil resources within each of the associations.

The Fox-Martinsville-Alluvial soil association comprises approximately 22 percent of the watershed area. It occupies outwash plains, terraces, and alluvial bottomland along the Whitewater River and its tributaries. The Fox and Martinsville soils are deep, well drained, and occur on nearly level to sloping areas. Fox soils are developed in sand and gravel deposits and are underlain by relatively clean sand and gravel at depths of 20 to 40 inches. Martinsville soils are developed in stratified sand and silt deposits most of which is free of gravel. The alluvial soil consists of Genesee, Eel, and Shoals soils which are intricately associated and difficult to identify as separate entities. These nearly level soils are deep and occupy bottomland areas along the Whitewater River and its tributaries. Genesee soils are well drained, Eel soils moderately well drained, and Shoals soils somewhat poorly drained. They are all subject to flooding.

The Hennepin-Fox soil association comprises approximately 3 percent of the watershed area. It occupies the breaks in high terraces and steep slopes of the uplands. The Hennepin and Fox soils are deep, well drained, and occupy strongly sloping to very steep slopes. Hennepin soils are developed in loamy glacial material. Fox soils are described above. Included in this association are small areas of Oakley, Milton, Randolph

and Millsdale soils are underlain at depths of 20 to 40 inches by limestone bedrock.

The Crosby-Brookston-Miami soil association comprises approximately 5 percent of the watershed area. It occupies uplands in the Wayne County area of the watershed and is developed in loamy glacial material. The Crosby soils are deep, somewhat poorly drained, and occupy nearly level to gentle slopes. The Brookston soils are deep, poorly drained, and occupy nearly level and depressional areas. The Miami soils are deep, well drained, and occupy gently sloping to moderately sloping areas. Included in this association are small areas of the Celina Series. Celina soils are similar to Miami except for being moderately well drained.

The Miami-Crosby-Fox soil association comprises approximately 17 percent of the watershed area. It occupies upland and small terraces in the Wayne County area of the watershed. The Miami and Crosby, described above are developed in loamy, glacial material. The Fox soils are deep, well drained, and occupy sloping to steep areas. They are developed in sand and gravel. Included in this association are small areas of the Brookston and Celina series.

The Fincastle-Brookston-Crosby soil association comprises approximately 2 percent of the watershed area. It occupies uplands in the Fayette-Union County area of the watershed and is developed in loamy glacial material. The Fincastle soils are deep, somewhat poorly drained, and occupy nearly level to gentle slopes. Brookston soils are described above. The Crosby soils have less depth of silt mantle than the Fincastle soils. Small areas of Miami and Russell soils are present in this association.

The Reesville-Birkbeck soil association comprises approximately 1 percent of the watershed area. It occupies uplands in the southeastern part of Wayne County and is developed in deep loess over glacial material. The Reesville soils are deep, somewhat poorly drained, and occupy nearly level to gentle slopes. The Birkbeck soils are deep, moderately well drained, and occupy nearly level to gentle slopes. Included in this association are small areas of Fincastle and Russell soils. These soils are developed in glacial loamy material with a deep silt cap.

The Russell-Xenia-Celina-Miami soil association comprises approximately 27 percent of the watershed area. It occupies uplands in the southern half of the watershed and is developed in loamy glacial material. The Russell and Xenia soils are similar to Miami and Celina except they have 18-20 inches of silt cap instead of the 0-18 inches of the Miami and Celina soils. The Russell soils are deep, well drained, and occupy nearly level to sloping areas. The Xenia soils are deep, moderately well drained, and occupy nearly level to gentle slopes. The Celina soils are deep, moderately well drained, and occupy nearly level to gentle slopes. Included in this association are small areas of Crosby, Fincastle, and Brookston.

The Fairmount soil association comprises approximately 2 percent of the watershed area. It occupies sloping to extremely steep areas adjacent to stream valleys and is formed from weathered limestone and shale. This association is mainly in the Franklin County area. The Fairmount soils are shallow to bedrock and well to excessively well drained. Included in this association are small areas of Milton and Hennepin. The Milton soils are similar to Fairmount except they are well drained and occupy less sloping areas. The Hennepin soils are developed in loamy glacial material and occupy similar slopes to that of Fairmount.

The Miami-Xenia-Hennepin soil association comprises approximately 4 percent of the watershed area. It occupies uplands in the southern part of the watershed and is developed in loamy glacial material. These soils are described above. Small areas of Fincastle and Brookston soils are included in this association.

The Fincastle-Brookston soil association comprises approximately 2 percent of the watershed area. It occupies uplands in the Franklin County area of the watershed and is developed in loamy glacial material. These soils are described above. Included in this association is Russell and Xenia soils.

The Miami-Ockley soil association comprises approximately 2 percent of the watershed and is located in the northeastern section. Miami soils in this association occur on upland slopes breaking onto the Ockley terraces. The Ockley soils are deep, well drained, and occupy nearly level to gentle slopes. Ockley soils are developed in sand and gravel deposits and are underlain by relatively clean sand and gravel at depths of 40 inches or more.

The Fox-Ockley-Wea-Warsaw soil association comprises approximately 1 percent of the watershed area. It occupies nearly level to strong slopes on terraces and outwash plains in the northeastern part of the watershed. The Fox soils are developed in deposits of sand and gravel with calcareous loose gravel and sand at 20 to 40 inches below the surface. The Ockley soils are similar to Fox except the depth to calcareous loose gravel and sand is greater than 40 inches. The Wea soil is similar to Ockley except the surface layer is darker colored. The Warsaw soil is similar to Fox except the surface is darker colored. Included in this association are small areas of Tackary soils. Thackary is similar to Ockley except for being moderately well drained.

The Miami-Celina-Kendallville soil association comprises approximately 6 percent of the watershed area. It occupies nearly level to strongly sloping area on the uplands in the northeastern part of the watershed and is developed in loamy glacial material. The Miami and Celina soils are described above. The Kendallville soils are deep, well drained, and occupy nearly level to gentle slopes. The Kendallville differs from Miami in that there is a small layer of gravel and sand between the subsoil and the parent material and the entire profile is more red in color than is typical for Miami. Included in this association are small areas of Crosby and Ockley soils.

The Celina-Crosby-Miami soil association comprises approximately 6 percent of the watershed area and occupies nearly level to strong slopes on the uplands in the northeastern part of the watershed. It is developed in loamy glacial material. These soils are described above. Included in this association are small areas of Brookston soils which are similar to Crosby with the exception of being poorly drained.

The Sloan-Eel-Ockley-Westland soil association comprises approximately 1 percent of the watershed area. It occupies nearly level to gentle sloping areas on alluvial bottomlands and terraces in the northeastern part of the watershed. The Sloan and Eel soils are formed from alluvial sediments. The Sloan soils are deep, poorly drained, and occupy nearly level to depressional areas on bottomlands along streams. The Eel soils are deep, moderately well drained, and occupy nearly level areas on bottomlands along streams. The Ockley and Westland soils are developed in gravel and sand deposits and are underlain with clean sand and gravel at depths of 40 inches or more. The Ockley soils are deep, well drained, and occupy

nearly level to gentle slopes on the terraces and outwash plains. Westland soils are deep, poorly drained, and occupy nearly level to depressional areas on the terraces and outwash plains. Included in this association are small areas of Sleeth and Shoals. The Sleeth soils are similar to Westland except for being somewhat poorly drained. Shoals is similar to Sloan except it too is somewhat poorly drained.

Nearly all the soils in the watershed area are well suited for growing a wide range of agricultural crops. The Fairmount and Hennepin soils are mainly suited to permanent pasture or growing trees due to the shallow soil and the steep slopes. Fox and Warsaw soils have a moderate drought limitation. Erosion is a hazard on sloping Miami, Celina, Russell, Zenia, Milton, Fox, Martinsville, Hennepin, Fairmount, Warsaw, and Kendallville soils. Crosby, Brookston, Fincastle, Reesville, Sleeth, Randolph, Millsdale, Sloan, and Shoals soils have wetness limitation and require drainage for growing crops. Genesee, Eel, Shoals, and Sloan soils are subject to occasional flooding during which time crops are subject to damage. Except for a limitation which might be imposed due to slope, most of the well and moderately well drained soils have relatively slight limitations for residential, industrial or recreational development. Milton, Randolph, Millsdale, and Fairmount soils would have a severe limitation for these uses due to limestone bedrock at 20 to 40 inches. The somewhat poorly and poorly drained soils have moderate to severe limitations for residential, industrial, or recreational development depending upon the degree of wetness. The bottomland soils have severe limitations for these uses due to the flooding hazard. Some recreational facilities could well be established on these soils within the limits of periodic flooding.

Fish and Wildlife Resources. The East Fork of the Whitewater River is a good smallmouth bass and rock bass fishing stream. The stream fishery resource is utilized only moderately by the local fisherman due to the limited stream access together with the attractiveness of Whitewater Lake. Other fish found in the East Fork and its tributaries include black crappie, longear sunfish, suckers, and numerous forage species.

Game animal population densities in the basin vary from poor to excellent, depending on the intensity and type of farming operations being practiced. The more important game species include squirrels, cottontail rabbits and bobwhite quail. Deer are present but do not provide for significant hunting pressure. Woodcock, waterfowl, raccoon, muskrat, mink and numerous songbirds and small mammals are also present in varying abundance. Overall hunting pressure is of moderate intensity.

Economic Data

Population. Estimated population of the watershed is 68,800 persons. Of this total, 50,200 are classified as urban and 18,600 as rural. Population is further distributed 61,400 to Indiana and 7,400 to Ohio. Approximately three-fourths of the Indiana population and one-third of the Ohio population are urban.

Principal population centers in the watershed include Richmond (44,200) and Liberty (1,800) in Indiana, New Paris (1,700) and New Madison (900) in Ohio. Overall population is increasing at an annual rate of approximately one percent. Such increases are occurring predominantly in the Richmond vicinity.

Trade, Social, and Cultural Centers. Principal centers of economic, social, and cultural activity in the watershed are the population centers of Richmond, Liberty, New Paris, and New Madison. Of these, Richmond is

of most importance. Mills and factories in the Richmond area turn out over 50 different products including automotive parts, machine tools, lawn mowers, ordnance materials, aircraft components, houseboat cabins, electrical machinery, transportation equipment and others. For each 100 persons employed in basic industries, approximately 150 additional people are employed in service and retail marketing capacities. Payroll for manufacturing establishments includes some 10,000 persons with an annual payroll in excess of 60 million dollars.

Social and cultural features of the watershed include Earlham College, Hayes Regional Arboretum, and a civic theatrical group. All are located at Richmond.

Historical Features and Points of Interest.^{1/} "Just west of Richmond is the Greenville Treaty Line Marker, which commemorates the treaty made in 1795 by General Anthony Wayne and the Indians under Chief Little Turtle, which opened a large part of Ohio and a small section of southeastern Indiana to white settlement".

"In Richmond is the Wayne County Historical Museum located in the Old Friends (Hick site) Meeting House, one of the finest museums of its kind in the country. A tablet at the corner of 7th and A streets indicates the spot where Henry Clay made a speech during the 1844 presidential campaign. It is said that this speech did much to cause his defeat. Just north of the town of Liberty is a marker at the birthplace of one of Indiana's poets, Joaquin Miller".

^{1/} From "A Tourist Guide to Historic Indiana", Dr. I. George Blake.

"The Whitewater River flows south from Richmond through one of the most picturesque parts of Indiana where many Quaker families settled over a hundred years ago. During the Civil War, this valley was the scene of a great deal of activity along the Underground Railroad. The beautiful Whitewater State Park is a major recreational area.

"Brookville, the seat of Franklin County, is a very interesting city. Several historic sites are located there. This was at one time a leading community of the State. It was the home of Senator James Noble, Governor James Brown Ray, Governor Noah Noble, Governor David Lawrence Wallace, father of General Lew Wallace, Senator Robert Hanna, three justices of the state supreme court, and one congressman. Lew Wallace, Civil War soldier and author of Ben Hur, was born here. The "ornate" window in the modest frame house of Governor Ray almost caused his defeat for election on the grounds of extravagance. This town is also the site of the first land office in Indiana.

"Just a few miles southeast of Brookville, on Road 52, is the little Cedar Baptist Church. This is claimed to be the oldest Protestant church building in the state still on its original foundations. It was built in 1810 and has been restored recently".

Land Use. A breakdown of current land use in the watershed is as follows: cropland, 62 percent; grassland, 12 percent; forest land, 13 percent; and other land, 13 percent. Forty-seven percent of cropland acreage is in row crop production, 25 percent in small grains, and 28 percent in hay. Less than one percent of present cropland is used for the production of truck crops.

Cropland represents approximately 70 percent of the floodplain on the upper portions of the East and Middle Forks upstream of Richmond, 60 percent on the lower portion of the East Fork main stem downstream of Richmond, and 30 to 50 percent on remaining floodplain areas.

Significant land areas in the "other land" category include portions of the incorporated area of Richmond (12.6 square miles), Whitewater State Park (2.4 square miles), and the Brookville Reservoir development currently under construction (27.4 square miles).

Crops, Yields, and Forests. Principal row crops grown in the watershed include corn and soybeans with corn occupying approximately three-fourths of the row crop acreage. Small grain acreages consist of 25 percent oats and 75 percent winter wheat. Mixed hay is grown on rotated meadowland. Acreages of small grain in the watershed are on the decline and row crops on the increase. Corn is the principal crop grown in floodplain areas.

Average crop yields for the watershed are corn - 90 bushels, soybeans - 26 bushels, oats - 50 bushels, winter wheat - 35 bushels, and hay - 2 tons. Flood-free yields in floodplain areas are typically 15 percent higher than these averages due to inherent differences in soils.

Woodland areas support stands of mixed hardwoods consisting primarily of oak-hickory, elm-ash-cottonwood, and maple-beech. About 55 percent of the forest stands are saw timber size, 21 percent pole timber, 20 percent seedling and sapling, and 4 percent non-stocked. Conversion of woodlands to cropland is currently underway and is expected to continue. An estimated 30 percent of all watershed woodlands are on soils suitable for agriculture.

Adequate forest fire protection is provided in Indiana by the Indiana Department of Natural Resources in cooperation with the U. S. Forest Service

through the Clarke-McNary Cooperative Forest Fire Control Program. The Ohio portion of the watershed is outside the State's forest fire protection zone. Adequate forest fire protection is provided for this area by local fire departments. Other current Federal-State Forestry programs include Cooperative Forest Management, Cooperative Forestation, and Cooperative Insect and Disease Control. Given protection, care and management, the forest land resource is expected to increase its contribution to the economy and environmental enhancement of the watershed.

Land Values. Agricultural land values in the watershed have been increasing at a rate of 1.5 percent per year. Current overall average value is \$325 per acre. Value of such land in the Indiana portion averages \$290 per acre, and in the Ohio portion \$460. Land values in Wayne and Randolph, the northernmost Indiana counties in the watershed, average 15 percent greater than those for the remaining Indiana portion.

Farms and Agricultural Sales. Farm size currently averages 170 acres. Trend in farm size has been toward a consolidation of available farm lands into fewer farming units. There are approximately 1,216 farms in the watershed. One hundred seventy-five (175) fewer farms were reported in 1964 within the watershed as compared to 1959.

Of the farms in the watershed 72 percent are of the commercial type, half of which have annual sales in excess of \$10,000. Twenty-two percent of total watershed farms are tenant operated, and 38 percent are operated by persons working off the farm 100 or more days each year. Farm sales generated in the watershed are composed of crops - 34 percent, forest and horticultural products - 7 percent, and livestock - 59 percent. Dairy sales comprise 23 percent of total livestock sales, poultry - 16 percent, hogs - 39 percent, cattle - 21 percent, and sheep - 1 percent.

Markets and Market Access. Market outlets for local agricultural products are available through farmer-owned grain cooperatives, local livestock auctions and slaughter facilities, and regional outlets outside the watershed. These facilities are adequate in meeting the marketing needs of the agricultural sector of the watershed. Local markets are good for quality sawlogs, veneer logs, and pallet material and fair for pulpwood. The market for most small forest products is generally good.

Access to trade and market outlets is provided through a well-developed network of roads. Principal north-south traffic route serving the area is U. S. Highway 27. This route passes through the center of the watershed at Richmond and links the watershed with the metropolitan areas of Fort Wayne, Indiana, to the north and Cincinnati, Ohio, to the south.

U. S. Highway 40, Interstate Highway 70, and U. S. Highway 35 serve the watershed to the east and west. Highway 40 and Interstate 70 link the watershed with the Indianapolis, Indiana, area to the west and the Dayton, Ohio, vicinity to the east. U. S. Highway 35 provides a connecting artery to the Muncie, Indiana, area.

Other principal routes serving the area are U. S. Highway 36 just north of the watershed; Indiana State Routes 227, 122, 44, 1, and 38; and Ohio State Roads 121 and 502. Approximately 1,600 miles of county roads supplement these principal traffic arteries.

Railroads serving the watershed are the Penn-Central and the Baltimore and Ohio. Four landing strips for small aircrafts are also present.

Land Treatment Data

The sponsoring soil and water conservation district recognize the importance of a sound land treatment program and have undertaken an active role in installing needed practices and improvements. To date \$3,001,011 have been expended by watershed landowners in installing approximately fifty percent of the needed land treatment measures. Forty-one percent of the watershed is covered by cooperative agreement with approximately 23 percent of the watershed area adequately treated.

Primary emphasis of the soil and water conservation districts in the Indiana portion of the watershed has been to assist in the development and implementation of basic conservation plans. Assistance for the installation of agricultural drainage measures, farm ponds, grassed waterways, and pasture plantings has also ranked high among the activities of the districts. Five hundred eighty-six watershed landowners representing 84,000 acres in Indiana are presently district cooperators. Three hundred forty-six of these have basic conservation plans covering nearly 50,000 acres. One hundred eighteen watershed landowners are present cooperators with the sponsoring Ohio soil and water conservation districts. Seventeen thousand acres are covered by agreement with these cooperators with 11,300 acres of this total covered by 82 basic conservation plans.

WATERSHED PROBLEMS

Land Treatment

Many areas of the watershed currently under cultivation have soils with severe to very severe erosion limitations. Such areas should be converted to grassland or woodland uses. Much of the remainder of land under cultivation in the watershed has moderate drainage and erosion limitations. Ability of these soils to produce efficiently both today and in the future requires an expanded effort in applying needed practices and improvements.

Development of additional on-farm water resources is needed to complement existing pasture enterprises, to encourage needed land use adjustments, and to provide an environment more pleasing to man.

Overall economic capabilities of landowners and operators in the watershed should present no serious restriction to application of needed land treatment practices and measures. An ambitious education and information program spearheaded by the local Soil and Water Conservation Districts is needed to effectively reach and motivate that segment of watershed landowners and operators who derive the majority of their income from non-farm sources.

Floodwater Damage

Frequent flooding occurs on terrace and bottomland soils adjacent to principal watershed drainages and at the outlets of numerous small, steep tributaries. Areas affected vary in width from a few hundred feet to a maximum of one quarter mile. Floodplain use is primarily agricultural. Minor amounts of residential development occur within infrequently flooded portions of the floodplain in the Richmond vicinity at the junction of the West Fork with the main stem, north of Richmond in the village of Middleboro, and within the New Paris, Ohio, area.

Approximately 6,230 acres of land within the watershed are inundated by a large flood (100 year frequency), 4,770 acres by a medium sized flood (4 year frequency), and 3,110 acres by a small flood (1 year frequency). The average annual area inundated is 7,000 acres, and reflects flood occurrences of two to three times each year.

Of the total floodplain area approximately 50 percent (3,090 acres) is located south of Richmond. Fifty-five percent of this area consists of floodplain along the main stem of the East Fork. The remainder occurs as narrow flooded bands along principal tributaries. Floodplain areas north of Richmond (3,140 acres) are distributed as follows: 8 percent on the West Fork, 49 percent on the Middle Fork, and 43 percent on the East Fork.

Agricultural damages from floodwater are most significant upstream of Richmond along the central portions of the East and Middle Forks (70 percent cropland) and downstream of Richmond on the lower portion of the main stem (60 percent cropland). Flooding in these areas occurs annually or more often. Row crops, primarily corn, occupy three-quarters of the cropland acreage with the remaining acreage evenly divided between small grains and hay.

Damages occurring on agricultural areas include reduced crop and pasture yields, increased crop production costs, and increased maintenance expenses on floodplain improvements. Constraints to floodplain land use and crop production processes resulting from flooding were not considered major problems in the watershed, except where occurring in conjunction with drainage impairment. Discussion of this aspect of watershed problems is presented under the heading of "Drainage." Reduced levels of farming activity observable in floodplain areas downstream of Richmond were believed due as much to technological displacement as to flood imposed constraints.

Damages to non-agricultural values are reflected primarily as increased maintenance expenses on a private channel recreation development on the Middle Fork, business loss to the development, increased costs for road and bridge maintenance in the Little Creek area north of New Paris, and nuisance-type damages to residential development in floodplain areas.

Floodwater damages within the zone of influence of project structural measures were estimated at \$33,861 annually to crop and pasture and \$930 non-agricultural interests (Table 5).

Erosion Damage

Sheet erosion occurs throughout the rolling upland areas of the watershed and serves as the primary sediment source contributor. Such erosion has been estimated to be severe on 10 percent of the watershed, moderate on another 30 percent, and within tolerable soil loss limits on the remainder. Reduction of sheet erosion throughout the watershed to tolerable limits is needed to insure the continued productivity of watershed soil resources.

Gully erosion is prevalent in the watershed but does not represent a major watershed damage. Such erosion occurs as extension of existing headcuts further entrenchment of present gullies, and formation of new lateral fingers. Areas affected are primarily in the steeply rolling uplands where storage slopes range from 5 percent upward. Most lands affected are either in pasture or woodland use with less than 5 percent of such lands having a history of crop production. Steep channel gradients and high flow velocities are prime contributors to the gully erosion problem.

Land damage from bank erosion and floodplain scour is severe in isolated segments of the watershed, but is of relatively minor importance to the area as a whole. Areas affected occur at intermittent points along

the West Fork north of Richmond, along Little Creek near New Paris, downstream of Richmond on the East Fork main stem, and on several major tributaries to the main stem in Union County. Damage results from destruction of valuable cropland and through reduced agricultural production on areas less seriously affected.

Erosion damages were not evaluated monetarily due to the apparent impracticality of formulating a structural program effective for their control.

Sediment Damage

Sediment generated through sheet, gully, and bank erosion and through floodplain scour is currently being deposited in two major water impoundment structures, Middle Fork Reservoir and Whitewater Lake. Accumulation of sediment in the Middle Fork Reservoir is currently displacing 24.5 acre-feet of usable water storage each year. This is expected to drop to an annual rate of 22.4 acre-feet in the future as a result of continuation of the Wayne County Soil and Water Conservation District program. Storage in the amount of 22.4 acre-feet is equivalent to that needed for 7 million gallons of water. Annual damages to the reservoir were estimated at \$9,924.

Deposition in Whitewater Lake is taking place at an annual rate of 25.3 acre-feet per year. Reduction in this rate to 14.2 acre-feet annually is expected through a continuation of the conservation program of the Union County Soil and Water Conservation District. Such deposition has already reduced the lake area of 36 percent is expected to occur within the next 100 years. Annual damages to the lake were estimated at \$18,630

Upon completion of the Brookville Reservoir, current rates of sedimentation will displace approximately 95 acre-feet of available storage each year. Such rates are expected to drop to 67 acre-feet under future conditions without project. Although provision has currently been made for sediment storage in the structure, such deposition represents an opportunity foregone in reappropriating current storage for unseen future beneficial uses. Value of this lost opportunity was estimated at \$4,940 annually.

Deposition of sediment is also occurring in watershed channels, road culverts and bridges, and in numerous small farm pond type structures scattered throughout the area. Increased expenditures for maintaining channel areas and road crossings result. Stream quality impaired, and useful life of farm ponds reduced.

Problems Relating to Water Management

Drainage. Shallow channel depth and inadequate channel capacity create agricultural drainage problems in the watershed. This problem occurs in conjunction with a floodwater problem on 282 acres in the upper most segment of the Middle Fork drainage north of Glen Karn, Ohio, (Reach A5), on 125 acres in the Baker Ditch Drainage (Reach A2), and on 194 acres in the New Madison, Ohio, vicinity on the East Fork (Reach D4). Present use of these areas is primarily diverted acres under the Feed Grain Program or row crop production. Approximately 16 acres of truck crops are currently grown in the water problem area of Reach A5.

Severity of the joint flooding and drainage problem is greatest in the New Madison vicinity with crop failure resulting in all but the driest years. Relief should be provided so the land can be used to its maximum capability.

Damaging effects of the problem are expressed through impaired root and plant growth, increased disease, greater competition from weeds, reduced crop quality and delayed field work. Costs of production are driven upward and yields downward.

Water Quality: Water quality on the East Fork main stem has been considered good in the past. The presence of few serious pollution problems together with generally adequate stream flow have contributed to this end. Recent questions concerning future water quality in the watershed have arisen, however. Pressures created through population and economic growth primarily in the Richmond, Indiana, vicinity threaten continued usefulness of downstream water resources.

State water quality criteria applicable to the maintenance of water areas for whole or partial body contact recreation indicate a deficiency in stream quality downstream of Richmond during periods of extended drouth. Sufficient dilution water is unavailable during such periods to assimilate treated sewage effluent discharged by the Richmond Sanitary District. Required corrective measures indicated by the Indiana Stream Pollution Control Board allow for two courses of action: (1) the installation of advanced waste treatment facilities, or (2) provision for low flow augmentation. Use of low flow water is viewed as only a stopgap solution, however, as advanced waste treatment for phosphate removal appears an unavoidable necessity once Brookville Reservoir is completed.

Normal base for application of state water quality standards is the minimum weekly stream flow which could be expected to occur once in a 10-year period. Such flow at Richmond would provide dilution water at a 2 to 1 ratio for only 4.7 million gallons per day of treatment effluent. This is far less than that needed for current daily discharges of 10 to 11 million gallons.

Seriousness of the problem becomes even more apparent in view of an anticipated 50 percent increase in sewage effluent release rates within a ten year period.

Other water quality problems within the watershed arise through sediment and nutrient pollution from agricultural lands, insufficient treatment of waste water from two industries, and inadequate treatment of sewage from a small municipality.

Municipal and Industrial Water Supply: Needs for additional municipal and industrial water which cannot be met through presently available ground water sources are limited to the City of Richmond. Present usage is approximately 13 million gallons per day, two thirds of which is drawn from the Middle Fork Reservoir, a privately owned and operated facility. Modification of the existing reservoir to provide additional water storage is anticipated within a two year period. Storage obtained through this modification is expected to be adequate until approximately 1985, at which time additional storage will be needed. Projections for the year 2020 indicate a water demand of 4.5 times the present usage rate.

Recreation Needs

Population growth, rising standards of living, and increasing amounts of time available for leisure time activities are creating ever increasing demands for outdoor, water-based recreation activities in the watershed and surrounding area. Present population within a 50 mile radius of the watershed has been estimated at 2.5 million. Increases to nearly 4.5 million are expected by the year 2000. Heavy contributors to this population pressure are the metropolitan areas of Dayton and Cincinnati, Ohio, to the east.

Inclusion of the metropolitan Indianapolis, Indiana, area to the west although just beyond the 50 mile perimeter, would add another one million persons to present population totals.

Estimates of water-based recreation "opportunity demand" originating from within the geographic area of the Whitewater Valley Conservancy District were presented in a recreation study prepared by Midwestern Engineers, Inc., a private consulting firm. Present demand for the District's population was estimated at 1.7 million visitor days. This demand was estimated to increase to 2.3 million visitor days by 1980 and 4.1 million visitor days by the year 2000.

Recreation facilities currently available within the District or planned for installation in the near future will not be adequate in meeting this demand. Indicated needs by 1980 include 359 additional campsites, an additional 15,555 acres of water for boating, 639 acres for fishing, 49 acres for sail boating, 2,124 acres for water skiing, and an additional 293,000 square feet of swimming beach. Need for additional hiking trails, nature walks, and canoe runs is also indicated. Consideration of the additional opportunity demand originating outside the Conservancy District even further dramatized the apparent need for expanded recreational facilities throughout the area.

PROJECTS OF OTHER AGENCIES

The Whitewater State Park is owned and operated by the State of Indiana. The Park includes a 185 acre lake located on Silver Creek near its junction with the East Fork of Whitewater River in Union County. Park facilities provide for swimming, camping, picnicking, and fishing. The planned structure on Silver Creek (No. 23B) north of Liberty will provide flood control to the park facilities, improve water quality by trapping sediment, and extend the recreation life of the lake.

Middle Fork Reservoir is a 175 acre lake located two miles north of Richmond, and serves as that city's major water supply. It is owned and operated by the Richmond Water Works Corporation. The reservoir is situated near the lower end of the Middle Fork of the East Fork of White-water River. The present capacity is one billion gallons with total design capacity of two billion gallons. Once maximum storage is utilized the reservoir will provide a water surface area of about 300 acres. No flood control or sediment storage is designed into the structure. Planned Structure No. 4A upstream of Middle Fork will improve water quality and provide additional usable water to the municipal water supply by storing sediment and providing sustained water flow into the reservoir.

Brookville Reservoir, a 5,260 acre lake (seasonal pool) for flood control and water supply, is now under construction by the U. S. Army Corps of Engineers. The dam is located at Brookville, Indiana, on the main channel of the East Fork of the Whitewater River near its junction with the West Fork of the Whitewater River. The seasonal pool stage extends upstream to the vicinity of Indiana Highway 44 west of Liberty. The maximum flood stage reaches north of Brownsville in northern Union County. This reservoir will be benefited by the watershed project through the reduction in sediment delivery and the control of storm runoff into the lake. The flood pool will be managed by the Indiana Department of Natural Resources, Division of Reservoirs. Food and cover for wildlife will be produced under a leasing arrangement with local farmers. Beneficial effects of the PL-566 project upstream will accrue to the flood pool through reduction of flood stages.

The Stream Pollution Control Board of the State of Indiana prepared and approved new amended rules concerning water quality standards for waters of Indiana, including the Whitewater River Basin. This action was made necessary by the Federal Water Quality Act of 1965. Conclusions 1/ which affected formulation of the watershed project were these: 1) Water Quality in the Whitewater Basin has been generally good; 2) Population in the basin is expected to nearly triple by the year 2020, increasing demands for water 4.5 times; 3) Improvements to the Liberty sewage treatment facilities are to be provided on or before the end of 1972; 4) Effluent chlorination facilities are to be provided by Richmond by the time of completion of the Brookville Reservoir; 5) Installation of advanced waste treatment or provision for low flow augmentation for Richmond will be required within 10 years (est. 1977); and 6) Agricultural pollution due to runoff is recognized and the State will continue to encourage proper land management through such programs as the Small Watershed Act - PL-566.

The Richmond Sanitary District has set a target date for the installation of advanced waste treatment of 1974. No other developments are planned or in existence which would affect or be affected by the planned PL-566 watershed project.

PROJECT FORMULATION

The project sponsors recognize the need and value of proper land treatment for controlling excess runoff and erosion in the watershed. A well balanced program leading to full development of land and water resources in

1/ From Report on Water Quality Criteria and Plan for Implementation, Whitewater River Basin, State of Indiana. Stream Pollution Control Board of the State of Indiana, March 1967.

the area is the desire of local sponsors. Strong interest is present for preserving not only future usefulness of these resources, but for expanding present use to the mutual benefit of all watershed residents.

A detailed description of soils in the watershed is offered due to the complexity of this resource. Hazards of steep slopes with high runoff and erosion create excessive damage to land, roads and channels. Limitations for uses such as recreation, residential or industrial development, and agricultural purposes are becoming increasingly important in this watershed. Urban expansion and new interests of the people are causing land use changes to occur. Proper soils information is basic to each land use decision, and the sponsors recognize this fact.

Lands now damaged by frequent flooding and/or lack of drainage outlets need more stable crop production through reduction of those risks. The level of flood protection desired is the highest level obtainable under feasible alternatives. A one to two year level of flood protection is generally satisfactory in the upstream areas where channel work is needed. Lesser flood protection can be tolerated downstream of Richmond where cropping is less intense.

Drainage needs are not widespread in the watershed. Most of these areas are located near the upper ends of the major tributaries which begin in Darke and Preble Counties. Outlet ditches of sufficient depth and capacity to provide excellent agricultural drainage are desired by the sponsors.

The Whitewater Valley Conservancy District, and the watershed Steering Committee in Ohio are keenly aware of the void in recreation opportunities in the watershed. A consulting engineering firm was therefore hired to study recreation needs in the area and recommend a course of action in

satisfying these needs through the Small Watershed Program. Based on this study and report, local sponsors have asked that all possibilities for developing recreation or fish and wildlife facilities be explored to their fullest. A well balanced program of recreation is desired so the specific interests of residents can be served. This would include swimming, boating, fishing, camping, picnicking, hiking, canoeing, riding, and general nature trails.

The Whitewater Valley Conservancy District employed a private engineering firm to help prepare preliminary recreation plans for Structures 23B and 35 and the channel between Richmond and Brookville Reservoir. The same firm helped the Steering Committee in Ohio develop a preliminary recreation plan for Structure 38.

Structure 23B is planned for about 113 surface acres. The design capacity for each major activity is 320 picnickers, 140 boaters, and 120 fishermen. Annual visitor days is expected to be about 19,500.

Facilities for Structure 35 with 474 surface acres will accommodate about 173,000 visitor days annually. Design capacity for each major activity is 720 campers, 1,250 picnickers, 652 hikers and 600 for nature trails, 112 boaters, 198 for water skiing, 248 fishermen, 1,450 swimmers, and an estimated 1,054 sightseers.

The channel area between Richmond and the Brookville Reservoir is planned for purchase and development as a "riverside greenstrip" to provide public recreation and opportunities and enhance fish and wildlife aspects of the area. This is a direct result of the recreation needs study for the area. Annual visitation is expected to be about 52,000 visitor days. Design capacity for each major activity is 275 picnickers, 330 hikers, 110 fishermen, 165 horseback riders, and 45 canoers.

Structure 38 at New Paris has 32 surface acres and will have an estimated 41,500 visitor days annually. Major activities and design capacity for each are 120 campers, 500 picnickers, 180 hikers, 60 boaters and fishermen, 20 shore-line fishermen, 450 swimmers, and an estimated 266 sightseers.

The City of Richmond needs water to meet the needs of a rapidly expanding area. Water to augment stream flow during drought periods will be needed to dilute up to 20 million gallons of sewage effluent per day if advanced waste treatment is not provided. Additional sources of water will also be needed for municipal and industrial use by 1985 according to current projections.

Population estimates for 1990 show that Wayne Township (Richmond) and surrounding area may expand from the present 50,000 to at least 85,000. The average daily water use by 1990 will equal the maximum capacity of the present sources. This will allow no potential for unexpected growth or unexpected increased uses by industry. Two potential reservoir sites which have been identified, appear to be the only remaining sites available in the watershed upstream from Richmond.

About 28 possible dam sites were studied for flood control, recreation and/or water supply possibilities. Many of these sites were alternate selections serving essentially the same area. Twenty-two dam sites and 40 miles of channel improvement were eliminated from consideration due to lack of economic justification. Many combinations of structures and channels were checked for their individual and combined effects on watershed damages. The combination of five multiple purpose structures, one single purpose structure, and 16.1 miles of channel improvement offers the greatest flood damage reduction which could be formulated under a feasible alternative. Recreation has been incorporated as a second purpose in three of the sites, and municipal and industrial water supply has been included in two other sites.

Yet these measures did not satisfy the need for erosion and runoff control on small scattered areas of the watershed. These are real and visable problems to the landowners. The Whitewater Valley Conservancy District felt that a project formulated to satisfy recreation, water supply and major flooding would not be acceptable to the majority of the landowners. These landowners were the ones who initiated the PL-566 application, but their problems were not solved. The sponsors requested that additional measures be studied, preferably through the land treatment program.

About 115 small structure sites were therefore located and studied as a possible addition to the land treatment problem to solve these problems. Of those studied, 47 have been selected as having significant on-site and off-site beneficial affects, and should be included in the project. These small structures were selected on the basis of effects, storage available or site limitations, cost in terms of area controlled, and conflicts with other planned or potential uses of the site. An expanded discussion of the effects of these special land treatment measures is presented under Effects of Works of Improvement.

To meet the objectives of the sponsors, extensive land treatment measures for erosion and runoff control are planned on an accelerated basis. During the eight year installation period, various vegetative and engineering practices will be installed with the technical assistance of the Service and the State Forestry Agencies, in cooperation with the U. S. Forest Service. Selective cost sharing will be provided by the Service and through the Agricultural Stabilization and Conservation Service.

New channel construction, reconstruction of existing channels, and limited clearing, shoal and obstruction removal are planned for the upstream areas of Ohio. These channels will provide flood protection and improved drainage conditions.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

Conservation Plan Measures. The sponsoring soil and water conservation districts of Wayne, Union, Randolph, Fayette, and Franklin Counties, Indiana, and Darke and Preble Counties, Ohio, recognize the importance of land treatment in an effective program for watershed protection and flood prevention. Provision for installation of land treatment measures at an accelerated pace within the watershed area has been made.

Measures to be applied on cropland areas include contour farming, contour strip cropping, grade stabilization structures, tile and open ditch drainage, diversions, terraces, ditch bank seeding, and pasture planting. In addition, conservation cropping systems will be established on numerous watershed farms incorporating such practices as crop residue use, minimum tillage, and plow planting.

Grassland treatment measures to be installed include pasture renovation and management, farm ponds and spring development. Measures to be applied on forest land consist of tree planting, hydrologic cultural operations, and woodland grazing control. Management plans and cultural prescriptions will consider the wildlife enhancement and other multiple use values of the forest land resource. Wildlife habitat management and development, field border planting and hedgerow planting will be applied on cropland, grassland and forest land where applicable, as will special plantings on other lands having a severe erosion problem.

Most of the above practices are applicable throughout the watershed. Flood and drainage problem areas will need particularly strong emphasis on application of minimum tillage, plow planting, crop residue use, tile, open ditches, ditch bank seeding, diversions, terraces and grade stabilization structures.

Special Measures. An important part of the land treatment phase of the East Fork of Whitewater River Watershed project involves installation of 47 water and sediment retention structures. These structures are located on the attached project map.

Surface area of permanent pools on these land treatment lakes is predominantly in the 8 to 20 acres range. Drainage areas controlled by these structures range from 105 acres to 1,315 acres while embankment heights vary from approximately 20 to 30 feet. The structures are to be earthfill dams with vegetated emergency spillways. All sites are to be designed and constructed to meet appropriate engineering criteria. As planned, 10 of the structures will be installed with corrugated or smooth steel pipe principal spillways. The remaining 37 sites will be installed with reinforced concrete principal spillways.

Many of the structures planned as special measures are situated close to existing county roads and can be utilized by the general public as recreation or fishing areas. Some sites are located in remote areas and may not be readily accessible for public use. Water quality is generally good at the selected sites, with mostly grassland and rather flat cropland with little or no development upstream from the proposed structures.

The planned special land treatment measures built with PL-566 and White-water Valley Conservancy District funds will have provisions for access to any member of the public. Adequate sanitary facilities will be installed and maintained in accordance with State and local health agency regulations.

Structural Measures

The structural measures to be installed consist of two multiple purpose, flood prevention and municipal and industrial water supply reservoirs; three multiple purpose, flood prevention and recreation reservoirs with related recreation facilities; one single purpose floodwater retarding structure; approximately 19.6 miles of multiple purpose flood prevention and drainage channel; and approximately 10.3 miles of channel recreation development.

Structures. Structure No. 4A has 6,234 acre feet of total storage of which 1,250 acre feet will be used as storage for submerged sediment and 4,070 acre feet will be used for municipal and industrial water supply. In addition this structure will temporarily detain 739 acre feet of floodwater or the equivalent of .73 inches of runoff from the drainage area above the structure. One hundred seventy-five acre feet of aerated sediment will be stored within the flood pool. A levee will be constructed on the watershed boundary west of State line road to the first intersection north, then road fill to elevation 1120. An access road will be constructed for an existing farmstead on the west side of the impoundment.

Structure No. 8 has 4,038 acre feet of total storage. Six hundred twenty-four acre feet of this will be used as submerged sediment storage and 2,932 acre feet as storage for municipal and industrial water supply. This structure will also temporarily detain 392 acre feet of floodwater or the equivalent of .41 inches of runoff from the drainage area above the structure with ninety

acre feet of aerated sediment to be stored within the flood pool. A levee will be constructed to elevation 1005 to protect the interstate highway and other property.

Structures No. 4A and 8 were planned to be constructed of earthfill and with reinforced concrete, flat trapexoidal weir, box inlet chute spillways. Flood control will be accomplished by a low stage weir. Each structure is planned to have a SAF stilling basin. A vegetated emergency spillway is provided for each site. The final detail design will incorporate the most economical features possible for each structure.

Fill material for the structures will be supplied largely by the excavated spillways. However, in Structure No. 8 some fill material will come from within the permanent pool. Sand and gravel lenses are interspersed in glacial till and where encountered will require blanketing with impervious materials.

Structure No. 35 has 9,800 acre feet of total storage of which 417 acre feet will be used as storage for submerged sediment and 6,633 acre feet as storage for recreation water. This structure will also temporarily detain 2,702 acre feet of floodwater or the equivalent of 3.68 inches of runoff from the drainage area above the structure. Forty-eight acre feet of aerated sediment will be stored within the flood pool.

Foundation conditions to the left (south) of the stream channel consist of 8 to 18 feet of sandy clay, clayey sand, and silty sand overlying bedrock which consists of clayey limestone interbedded with shale. To the right of the stream channel the bedrock slopes rapidly to a depth of about 50 feet at the base of the right abutment. Overlying unconsolidated materials consist primarily of sandy clay and clayey sand interlayered with silty sand and

silty gravel. Rock excavation will be encountered in the core trench on the left side of the stream and possibly in the excavation for the principal spillway. A positive cutoff to rock is not planned on the right side of the floodplain due to the excessive depth to bedrock. The preliminary design and cost estimate reflects the need for blanketing a portion of the pool area with relatively impermeable materials.

Location of the structure is on Niewoehner Road. The structure will be constructed of earthfill with a top width of 36 feet to accommodate the road. The north abutment of the dam will be constructed at 10:1 slope where the county road crosses the vegetated emergency spillway. The control section will be located downstream on the west side of the road. A splitter dike equal in height to the flow depth at the emergency spillway hydrograph + 1.0 foot will be maintained from the control section to the outlet. The principal spillway will be of reinforced concrete with a drop inlet and a SAF outlet.

The recreation facilities area related to Structure No. 35 is located on 637 acres of land adjacent to a 763 acre water resource area. Actual permanent water surface area is 474 acres. Recreation features include provision for camping, picnicking, hiking, nature walks, swimming, boating, water skiing and fishing.

Structure No. 23B has 3,270 acre feet of total storage of which 726 acre feet will be used as storage for submerged sediment and 1,024 acre feet will be used for recreation. This structure will also temporarily detain 1,142 acre feet of floodwater or the equivalent of 2.95 inches of runoff from the drainage area above the structure. One hundred thirteen acre feet of aerated sediment will be stored within the flood pool.

The structure foundation is glacial till over limestone bedrock. Core trench and structure excavation will be in rock. A reinforced concrete principal spillway with a covered drop inlet and impact basin outlet is planned. The dam will be earthfill with a vegetated emergency spillway.

The recreation facilities area related to Structure No. 23B is located on 180 acres adjacent to a 260 acre water resource area. Surface area of the permanent water pool is 113 acres. Recreation features include provision for picnicking, boating, and fishing.

Structure No. 38 has 647 acre feet of total storage of which 78 acre feet will be used as storage for submerged sediment and 436 acre feet will be used for recreation. In addition, the structure will temporarily detain 133 acre feet of floodwater which is equivalent to 2.3 inches of runoff from the drainage area above the structure.

Foundation material is glacial till shallow to bedrock. A positive cutoff into bedrock is planned. Rock excavation for the core trench and principal spillway is anticipated. A reinforced concrete principal spillway with a covered drop inlet and impact basin outlet is planned. The dam will be earthfill with a vegetated emergency spillway.

The recreation facilities area related to Structure No. 38 is located on 60 acres of land adjacent to a 65 acre water resource area. Surface area of the permanent water pool is 32 acres. Recreation activities provided for include swimming, boating, picnicking, and fishing.

Structure No. 28 is a single purpose floodwater retarding structure. It will temporarily detain 396 acre feet of floodwater. Foundation material is glacial till over limestone. A positive cutoff to rock is planned with rock excavation for the core trench anticipated. The structure will be earthfill with a vegetated emergency spillway.

A summary of the relocations that will result from acquisition of land rights is shown in the table below:

Item	Structure Number					Total
	4A	8	23B	35	38	
<u>Displacements</u>						
Farm Operation	7	-	1	9	1	18
Business	-	-	-	-	-	-
Dwelling: Owner	10	4	1	6	2	23
Tenant	5	1	1	4	-	11
Mobile Home	2	-	-	-	-	2
TOTAL	24	5	3	19	3	54
<u>Displaced Persons</u>						
Owner - occupied	41	20	2	17	5	85
Tenant - occupied	27	3	4	17	-	51
TOTAL	68	23	6	34	5	136

The six structures planned control 70.7 square miles or 24 percent of the drainage area at a point on the main just upstream of Hannah Creek. Their combined capacities are as follows: 5,774 acre feet for flood detention, 8,093 acre feet for recreation, 7,002 acre feet for municipal and industrial water supply, 522 acre feet for aerated sediment and 3,198 acre feet for submerged sediment for a total storage of 24,589 acre feet.

All structures will be provided with drainage outlets to allow drawdown for maintenance of the pool area, dam and spillway, as well as fish management purposes. Earth dam and spillway areas will be seeded to adapted grass and legume species. Standing timber left in lateral arms and upper reaches of water impoundments to serve as fish and wildlife attractors will be considered by individual structures prior to final design. Factors to be considered are local and state air and water pollution regulations, safety and liability for accidents, use planned for each site and spillway maintenance. Personnel of the Indiana Division of Fish and Wildlife and the Ohio Division of Wildlife will be consulted during design stages with regard to the establishment and maintenance of project fisheries and the development of measures for wildlife benefit.

Specific design information for the six structures to be installed is presented in Table 3. Table 2B relates types, number and costs of recreation facilities to be installed in association with multiple purpose structures No. 35, 23B and 38. Recreation development maps appear as attachments at the rear of this plan and present general information regarding the proposed layouts of the structure recreation facilities.

Also appearing as attachments at the rear of this plan are illustrations showing (1) "Cross Section of Typical Multiple Structure," (2) "Typical Principal Spillway with Drawdown Feature," and (3) "Reinforced Concrete Box Inlet

Chute Spillway." The typical multiple structure cross section has particular relevance to Structures No. 35, 23B and 38. The illustration is also relevant to Structures No. 4A, 8 and 28 but would require substitution for the type principal spillway shown. The principal spillway referred to under Item 2 above applies to Structure No. 28. Item 3 refers to the suggested type of principal spillway for Structures No. 4A and 8.

East Fork Channel Recreation Development. The planned channel recreation development includes land on both sides of the channel from Richmond downstream to Abington. This includes some 10.3 miles of stream channel with four access points and will be 465 acres in size. Recreation features to be provided include hiking, nature walks, horse trails, bicycling, fishing, picnicking and canoeing. The amount and locations of the recreation facilities are shown on the recreation map and on Table 2B of the plan. The Indiana Division of Fish and Wildlife will be consulted during the design stages in regard to establishment and maintenance of project fisheries and development of measures for wildlife benefit.

Channels. Middle Fork (Reach A5) channel improvement commences on the section line between Sections 20 and 29, T-11-N, R-1-E, in Darke County, Ohio, and continues in southerly direction to 1,400 feet below the East-West county road in Section 7, T-10-N, R-1-E. This segment, consists of approximately 3.9 miles of channel.

Middle Fork Lateral No. 1 (Reach A5) channel improvement commences at the tile headwall in the SW corner of the NE $\frac{1}{4}$, NE $\frac{1}{4}$, Section 28, T-11-N, R-1-E, Darke County, Ohio, and continues in a westerly direction to its junction with the Middle Fork. This segment consists of approximately 1.6 miles of channel.

Baker Ditch (Reach A2) channel improvement commences at the new headwall to be constructed on section line between Sections 7 and 8, T-9-N, R-1-E, Preble County, Ohio, continuing its northerly direction into Darke County, Ohio. Looping in a west and southwesterly direction the channel reenters Preble County, Ohio, in Section 6, T-9-N, R-1-E, outletting along the state line into Mud Creek. This segment consists of 3.6 miles.

Baker Ditch Lateral No. 1 (Reach A2) channel improvement commences on the section line between Sections 5 and 8, T-9-N, R-1-E, Preble County, Ohio, and continues in a northerly direction to its junction with Baker Ditch, consisting of approximately .2 miles of channel.

East Fork of Whitewater River (Reach D1-3) channel improvement commences in the NE $\frac{1}{4}$, Section 23, T-10-N, R-1-E, Darke County, Ohio, and continues in a southwesterly direction to the junction with Joe Hill Ditch. No work is planned from Joe Hill Ditch downstream to the Preble County Line. Work commences at this point and continues on downstream through the county road bridge located in the SE $\frac{1}{4}$, SW $\frac{1}{4}$, Section 30, T-9-N, R-1-E. This segment consists of 8.3 miles.

East Fork Lateral No. 1 (Reach D4) channel improvement commences at the new headwall to be constructed on the east side of the road in the SW corner of Section 7, T-10-N, R-2-E, Darke County, Ohio, and continues in a southwesterly direction to its junction with the East Fork. Such improvement consists of approximately 2.0 miles of channel.

Channel designed capacities approximate a two year frequency on Baker Ditch and Baker Lateral No. 1 (Reach A2), Middle Fork Lateral No. 1 and the upper portion of Middle Fork (Reach A5), East Fork Lateral No. 1 and the upper portion of East Fork (Reach D3-4). Designed capacities decrease to

approximately a one year frequency on the lower portion of Middle Fork (Reach A5) and the lower segment of East Fork (Reach D1&2).

Channel improvements traverse through glacial till for the most part in all segments except East Fork Lateral No. 1, where a shallow muck is encountered. No construction problems are anticipated in this area, however, as the underlying material is quite stable. Type of construction for channel improvements is shown on Table 3A and is designated as C (clearing only), CE (channel excavation), C and CE (clearing and channel excavation), and C and SR (clearing and shoal removal). A brief description of each type of construction follows.

Clearing will consist of removing woody vegetation at or near ground level within the channel. Trees ten inches or greater in diameter to remain on west and south channel side slopes, will be selected by State and Federal foresters and biologists, the project engineer, and a local sponsor representative. Consideration will also be given to leaving selected stands of trees in an effort to maintain and improve the overall quality of the environment.

Channel excavation is to be done from one side only to a 2 to 1 side slope. Spoil is to be placed beginning at the excavated channel bank on a 3 to 1 slope not to exceed three feet in depth. Field slope of spoil material will be at an 8 to 1 in glacial till areas. Spoil is to be leveled on East Fork Lateral No. 1.

Clearing and channel excavation will consist of removing existing channel side slope woody vegetation at or near ground level with excavation limited to one side of the channel and in the channel bottom. Excavated channel side slopes will again be at a 2 to 1 with spoil placement as previously described.

Clearing and shoal removal will consist of removal of woody vegetation at or near ground level from side slopes with dipping of the channel bottom to line and grade. Spoil placement will be the same as previously described.

All excavated side slopes and channel sides of spoil will be seeded to grass. Herbaceous plantings for wildlife cover are planned at the top of spoil banks. Fencing of spoil bank areas will be done where subject to continuous pasturing. Permanent easement limits will be clearly marked with durable markers to protect from encroachment of farming activities. Rock and log channel deflectors will be placed within the most downstream 2.3 miles of channel improvement on the East Fork for the preservation of fishery values (Reach D1&2). The Ohio Division of Wildlife will be consulted during the design stages with respect to establishment and maintenance of project fisheries and development of measures for wildlife benefit.

Appurtenances are planned to safely lower surface waters into improved outlets. Tile lines encountered in constructions will be outletted into the improved channel.

Four county road crossings will be needed on East Fork Lateral No. 1. All other bridges are adequate and require no under-pinning.

EXPLANATION OF INSTALLATION COSTS

Land Treatment Measures

The cost of installing the land treatment measures are summarized in Table 1. Estimated total cost for technical assistance is \$767,520 of which \$267,000 will be funds from the going program and \$500,520 from PL-566 funds. These funds will insure the needed acceleration of the total land treatment program. Land owners and operators will spend an estimated \$2,716,467 for measures installed on their lands. An additional cost of \$670,800 for the installation of the special measures program is provided of which \$335,400 will be PL-566 costs and \$335,400 Whitewater Valley Conservancy District costs.

Obligations for the installation of the land treatment program are scheduled as follows:

<u>F. Y.</u>		<u>PL-566</u>		<u>Other</u>		<u>Whitewater Valley Cons. District</u>
		<u>Indiana</u>	<u>Ohio</u>	<u>Indiana</u>	<u>Ohio</u>	
1st	L. T. Meas.	41,925	-	247,705	136,800	41,925
	Tech. Asst.	48,045	13,745	28,835	4,550	-
2nd	L. T. Meas.	41,925	-	247,705	136,800	41,925
	Tech. Asst.	49,045	13,745	28,835	4,550	-
3rd	L. T. Meas.	41,925	-	248,705	136,800	41,925
	Tech. Asst.	49,045	13,745	28,835	4,550	-
4th	L. T. Meas.	41,925	-	248,705	136,800	41,925
	Tech. Asst.	50,045	13,745	28,835	4,550	-
5th	L. T. Meas.	41,925	-	250,705	136,800	41,925
	Tech. Asst.	50,045	13,745	28,835	4,550	-
6th	L. T. Meas.	41,925	-	250,705	136,800	41,925
	Tech. Asst.	48,945	13,745	28,835	4,550	-
7th	L. T. Meas.	41,925	-	250,705	136,790	41,925
	Tech. Asst.	48,045	13,745	28,835	4,550	-
8th	L. T. Meas.	41,925	-	248,105	136,357	41,925
	Tech. Asst.	48,045	13,745	28,855	4,450	-

Structural Measures

Installation cost for structural measures as shown in Table 2 include construction, land rights, engineering, relocation payments, and project administration costs. The table shows the total PL-566 and Other costs.

Construction cost is the estimated contract cost for constructing structural measures, and is based on a 1969 price base. Actual construction cost will vary as the price base varies. It includes all materials, labor and the use of machinery involved in construction. A 15 percent contingency allowance is added to the estimated contract cost for all works of improvement except the recreational facilities which have a 10 percent contingency allowance. The contingency allowances are to defray any unexpected cost that may occur during construction.

Engineering cost is the cost for preparing construction plans for the structural measures. These costs include the direct cost of engineers, geologists, and technicians for construction surveys and investigations, soil and foundation drilling and testing, design, and preparation of construction plans and specifications.

Land rights costs include all expenditures for: (1) acquisition of land rights, the value of which is estimated by the local organization; (2) the closing, relocation, raising of private, county or state roads; (3) purchasing buildings, or other improvements; (4) purchasing in fee simple title the land and improvement that are required for all multiple purpose structures; (5) purchasing in fee simple title the land and improvement involved in the recreational development areas; (6) relocation or reconstruction of fences; (7) relocation or removal of utility lines; (8) all legal fees, surveys associated with acquisition of land, land rights or permissible flooding.

The minimum land rights needed for the single purpose floodwater retarding structure and the multiple purpose structures for municipal and industrial water supply, include the area for the dams and emergency spillways, and ingress and egress to the structure site. For recreation reservoirs, if the design flow depth in the emergency spillway is less than two feet, the land area required for purchase is that area encompassed by the contour line that is two feet higher than the crest of the emergency spillway or 100 horizontally from the contour at emergency spillway elevations, whichever is greater. Land required for channel improvement includes a permanent easement on that land between the outside top edges of spoil banks or 15 feet on each side of the top of the ditch slope if spoil is to be graded.

The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 - Public Law 91-646 (84 Stat. 1894) provides for services and payments to a displaced person, business or farm operation directly affected by project works of improvement.

Relocation assistance advisory services are applicable whenever the acquisition of real property for a project will result in the displacement of any person business, or farm operation. The costs incurred for relocation assistance advisory services are the responsibility of each sponsoring local organization involved with land acquisition. These services include serving notice of displacement, providing appropriate application forms, assisting in filing applications, hearing and resolving grievances, and making relocation payments. The Service will bear the costs they incur as part of the overall project administration costs, and will assist the Whitewater Valley Conservancy District and the Jefferson Township Park District in providing these services.

Relocation payment costs are applicable to a displaced person, business, and farm operation. The amount includes moving and related expenses for a displaced person, business, or farm operation as well as financial assistance for replacement housing for a displaced person who qualifies and whose dwelling is acquired because of the project.

Project administration costs are the PL-566 and Other administration costs associated with the installation of the works of improvement. Included are the costs of relocation assistance advisory services, contract administration, review of engineering plans prepared by others, Government representatives, and necessary inspection service during construction to insure that structural measures are installed in accordance with the construction plans and specifications.

Cost Allocation. Joint installation costs on multiple purpose structures were allocated by the Alternative Justifiable Expenditure Method. This method involves assignment of joint costs to purpose based on a relationship of benefits. Multiple purpose channel costs were allocated by the method which involves the relationship of area benefited by the channels to total drainage area. Cost allocation procedures and methods are covered fully under Economics in the Investigations and Analyses section of this plan. Specific costs related to each measure are noted on Table 2, and costs allocated to each purpose for each measure are listed on Table 2A.

Cost Sharing. Cost sharing is as follows: PL-566 costs are 100 percent of construction costs allocated to flood prevention; 50 percent of the construction costs allocated to drainage; 50 percent of multiple purpose structure construction costs allocated to recreation; and 50 percent of recreation facility construction costs on Structures No. 23B, 38 and the south segment of 35. Except for relocation payments, PL-566 cost sharing will not be provided for any portion of installation costs, allocated to municipal

and industrial water supply for Structures No. 4A and 8, nor any portion of installation costs for the north segment of Structure No. 35 recreation facility, or the channel recreation development.

All remaining construction costs allocated to drainage and recreation will be borne by other funds. The entire amount of installation costs, except relocation payments, allocated to municipal and industrial water supply on Structures No. 4A and 8, the north segment of recreation facilities at Structure No. 35, and the channel recreation development will be borne by other funds.

Engineering costs allocated to flood prevention and drainage for all structural measures and such costs allocated to recreation on multiple purpose Structures No. 35, 23B and 38 will be borne entirely with PL-566 funds. Engineering costs associated with the recreation facilities on Structures No. 23B, 38 and the south segment of No. 35 will be borne 50 percent with PL-566 funds and 50 percent with other funds, except for engineering associated with the baseball diamond, basketball court, and tennis court related with No. 35 - south recreation facility.

All land rights costs allocated to flood prevention and drainage will be paid by other funds. Land rights for Structures No. 23B, 35 and 38 and for recreation facilities on these structures, except for legal fees, surveys, flowage easements, and the north segment of Structure No. 35 recreation facility, will be borne 50 percent with PL-566 funds and 50 percent with other funds.

Relocation costs allocated to flood prevention, recreation, and municipal and industrial water supply on Structures 4A, 8, 23B, 35 and 38 will be borne 30.60 percent with PL-566 funds and 69.40 percent with other funds. These cost sharing percentages, which will be applicable after July 1, 1972, are based upon the ratio of PL-566 funds and other funds to the total

project costs less relocation payments. For those displacements prior to July 1, 1972, PL-566 funds will provide the first \$25,000 for each displacement.

All project administration costs, including relocation assistance advisory services, will be paid by each sponsoring local organization without PL-566 cost sharing. The Service will bear the costs they incur and will assist the White-water Valley Conservancy District and the Jefferson Township Park District in providing these services.

Project Costs in Ohio. The following works of improvement are located in the State of Ohio: Multiple purpose floodwater retarding and recreation Structure No. 38 and related facilities and all multiple purpose flood prevention and drainage channel improvements. Total construction cost on multiple purpose Structure No. 38 is \$107,420 and on the associated recreation facility is \$266,770. The PL-566 cost for construction is \$55,751 for the structure and \$124,635 for the recreation facilities. The Jefferson Township Park District construction cost for the structure is \$51,669 and for the recreation facilities \$142,135. The structural engineering services of \$10,740 are all PL-566 costs. Recreation facilities engineering services total \$17,500 of which \$8,750 are a PL-566 cost and \$8,750 is a cost to the Jefferson Township Park District. Land rights costs on the structure and the recreational development is \$69,090 of which PL-566 are \$32,875 and the cost to the Jefferson Township Park District is \$36,215. Relocation costs on the structure are \$20,300 of which PL-566 costs are \$6,210 and the costs to the Jefferson Township Park District is \$14,090.

The total construction costs on the multipurpose channels are \$192,800 of which PL-566 costs are \$188,511, Preble County Commissioners' costs are \$1,703 and Darke County Commissioners' costs are \$2,586. Total engineering services costs are \$19,330 which are PL-566 costs. Land rights costs are \$58,440 of which Darke County Commissioners' costs are \$52,290 and Preble County Commissioners' costs are \$6,150.

Summary of the costs involved in the State of Ohio is as follows:

	<u>PL-566</u>	<u>Jefferson Twp. Park District</u>	<u>Preble Co.</u>	<u>Darke Co.</u>	<u>Total</u>
Construction	\$368,897	\$193,804	\$1,703	\$ 2,586	\$566,990
Engineering Services	38,820	8,750	-	-	47,570
Land Rights	32,875	36,215	6,150	52,290	127,530
Relocation Payments	5,200	11,780	-	-	16,980
Project Administration	<u>113,395</u>	<u>14,220</u>	<u>1,920</u>	<u>3,850</u>	<u>133,385</u>
Total	\$559,187	\$264,769	\$9,773	\$58,726	\$892,455

Project Costs in Indiana. The following works of improvement are located in the State of Indiana. Floodwater retarding Structures No. 28, multiple purpose floodwater retarding and recreation Structures No. 23B and 35 with related recreation facilities multiple purpose floodwater retarding and municipal and industrial water supply Structures No. 8 and 4A and the channel recreation development.

Total construction costs on multiple purpose Structure No. 8 are \$455,510 of which \$54,432 are PL-566 costs and \$401,078 are Whitewater Valley Conservancy District costs. Total engineering costs are \$45,550 of which \$5,443 are PL-566 costs and \$40,107 are Whitewater Valley Conservancy District costs. Land rights costs of \$124,000 are costs to the Whitewater Valley Conservancy District. Alterations to existing facilities at No. 8 include: Levee along flood pool to protect the interstate highway and other property-\$20,000 construction cost and three houses - \$18,000 land rights cost.

Construction costs for Structure No. 4A and \$449,110, of which \$49,402 are PL-566 costs and \$399,708 are Whitewater Valley Conservancy District costs. Engineering services costs are \$44,910 of which \$4,940 are PL-566 costs and \$39,970 are Whitewater Valley Conservancy District costs. Land rights of \$279,200 are costs to the Whitewater Valley Conservancy District.

Engineering services cost are entirely PL-566 and are estimated to be \$26,180. Land rights costs are \$34,475 of which PL-566 costs are \$15,325 and the Whitewater Valley Conservancy District costs are \$19,150.

Construction costs for recreation facilities on Structure No. 23B are \$76,430 of which PL-566 costs are \$37,215 and Whitewater Valley Conservancy District costs are \$39,215. Engineering services costs are \$5,000 of which \$2,500 is a PL-566 cost and \$2,500 is a cost to the Whitewater Valley Conservancy District. Land rights on Structure No. 23B facilities are \$77,380 of which the PL-566 cost is \$36,500 and the Whitewater Valley Conservancy District cost is \$40,880.

Construction costs for multiple purpose Structure No. 35 are \$393,840 of which \$195,018 are PL-566 costs and \$198,822 are Whitewater Valley Conservancy District costs. Engineering services costs of \$36,385 are paid entirely by PL-566. Land rights costs of \$302,200 are divided \$144,550 to PL-566 and \$157,650 to Whitewater Valley Conservancy District.

Construction costs of \$608,745 for the south recreation facilities at Structure No. 35 will be divided between PL-566 and the Whitewater Valley Conservancy District, with costs assigned \$286,622 and \$322,123, respectively. Engineering services for the south recreation facilities are \$41,200, of which \$20,000 are PL-566 costs and \$21,200 are Whitewater Valley Conservancy District costs. Land rights costs for the south recreation facilities are estimated to be \$307,500 and are shared \$145,075 by PL-566 and \$162,425 by the Whitewater Valley Conservancy District.

Costs for the north recreation facilities at Structure No. 35 will be borne wholly by the Whitewater Valley Conservancy District. The estimated costs are \$349,430 for construction, \$25,000 for engineering services, and \$197,100 for land rights.

Channel recreation development and related facilities construction costs are \$255,750, engineering services are \$23,500, and land rights are \$133,750. All of these costs are to be borne by the Whitewater Valley Conservancy District.

Floodwater retarding Structure No. 28 construction costs are \$46,400 and are to be paid by PL-566 funds. Engineering services of \$4,600 are also PL-566 costs. Land rights costs are \$30,000 and will be a cost to the Whitewater Valley Conservancy District.

Relocation costs related to Structures No. 4A, 8, 23B and 35 are estimated to be \$157,670, of which \$48,240 are PL-566 costs and \$109,430 are Whitewater Valley Conservancy District costs.

A summary of the project costs incurred in Indiana is shown on the table below:

	<u>PL-566</u>	<u>Whitewater Valley Conservancy District</u>	<u>Total</u>
Construction	\$ 820,813	\$2,088,222	\$2,909,035
Engineering Services	100,048	152,277	252,325
Land Rights	341,450	1,144,155	1,485,605
Relocation Payments	48,240	109,430	157,670
Project Administration	<u>505,770</u>	<u>136,340</u>	<u>642,110</u>
Total	\$1,816,321	\$3,630,424	\$5,446,745

An estimated schedule of PL-566 and Other obligations for installation of the structural measures by fiscal year is tabulated below. Project administration costs are not included in this table.

<u>F.Y.</u>	<u>PL-566 Indiana</u>	<u>PL-566 Ohio</u>	<u>Preble County</u>	<u>Darke County</u>	<u>Jefferson Twp. Park District</u>	<u>Whitewater Valley Cons. District</u>
1st	181,885	32,450	4,640	5,100	25,000	197,590
2nd	383,729	143,738	477	47,370	31,745	307,796
3rd	307,268	114,701	1,510	1,750	51,669	418,822
4th	311,255	154,903	1,226	656	142,135	635,490
5th	54,432	-	-	-	-	751,078
6th	22,580	-	-	-	-	404,350
7th	49,402	-	-	-	-	523,208
8th	-	-	-	-	-	255,750
TOTAL	<u>1,310,551</u>	<u>445,792</u>	<u>7,853</u>	<u>54,876</u>	<u>205,549</u>	<u>3,494,084</u>

EFFECTS OF WORKS OF IMPROVEMENT

Land Treatment

Conservation Plan Measures. Conservation benefits to land treatment measures will be realized on 64,155 acres of cropland, 17,129 acres of grasslands, 2,184 acres of forest land, and on 5,488 acres of other land.

Such benefits accrue on-site and are evidenced through damage reduction and through increased efficiency in the production of crops, pasture, timber and wildlife.

Measures to be applied on cropland such as contour farming, contour strip cropping, terraces, diversions, minimum tillage, plow planting, conservation cropping systems, pasture planting, and grade stabilization structures will reduce erosion by approximately 34 percent through interception or reduction of runoff and through stabilization of drainageways. Reduced sheet erosion permits inherent soil fertility to be maintained. A reduction in crop damage associated with poor stands will also result, as will a reduction in permanent land damage caused by gully erosion. Measures such as minimum tillage, plow planting, and conservation cropping systems will provide an additional benefit through improvement of soil structure and through an enhancement of the general soil environment. Conditions under which plant growth occurs are thereby improved.

Removal of surplus surface and/or internal water in soils through installation of tile and open ditch drainage measures will enhance crop growth in watershed wetland areas. Reduced costs, improved crop quality, and increased yields resulting from installation of these measures spell increased profitability to the farm enterprise.

Application of pasture renovation and management practices will improve the overall quality and productivity of grassland areas to be treated. Such areas when properly treated and managed complement the overall farm operation, contributing significantly to farm income with a minimum of erosion risk. Installation of farm ponds add to the value of farm pasture enterprises in providing water supply for livestock. The 230 ponds to be installed will in addition create needed aquatic habitat benefitting fish and wildlife values throughout the watershed.

Protection and the multiple use management of the forest land resource will improve hydrologic condition. This will reduce erosion and sedimentation and retard storm runoff. Intensified management will increase the productivity of the resource and enhance wildlife and recreation values. Benefits will accrue that contribute substantially to the beautification, aesthetic appeal, environmental quality and subsequent use of the watershed resource.

Most species of wildlife will benefit from the installation of land treatment measures. Measures such as hedgerow planting, field border plantings, and wildlife habitat management and development are intended specifically to create protective cover needed for the perpetuation and possible increase of wildlife numbers. Other land treatment measures including contour strip cropping, grassed waterways, ditch bank seeding, and critical area plantings contribute indirectly to this end in adding to the quantity of protective cover available.

Stabilization of severe erosion areas on miscellaneous watershed lands will preserve such area for future use, enhancing at the same time the natural beauty of the area.

In addition to these on-site benefits, significant off-site benefits will accrue to this portion of the land treatment program. Land treatment measures installed above structural improvements provide the basis for reduced structural cost, improved efficiency of structural operation, and extended structural life. Such measures have an additional effect in reducing flood damages on watershed floodplain areas. Storm runoff from the entire watershed area will be reduced by an average of 1 percent. Flood damage reduction benefits attributable to the land treatment program were evaluated at \$6,508 annually. (footnote 2, Table 6).

Special Measures. Structures to be installed as part of the land treatment program will provide a wide range of benefits both on-site and off-site. Water stored in permanent pool areas will be used for stock water, fire protection,

supplemental irrigation, recreation, and fish and wildlife purposes. Such water when impounded over points of active gully formation will stabilize critical erosion problems. Land damage and downstream sedimentation will be reduced. Ground water reserves will be increased.

In addition to the above benefits, storage of permanent water will enhance the natural and aesthetic values of the rural countryside. Favorable locations for scattered homesite developments will be created, encouraging a more even distribution of population throughout the watershed.

Detention storage will reduce peak flows in downstream areas immediately below structures. Stabilization of many channel areas will result producing corresponding decreases in sedimentation. Required maintenance for cleanout of road culverts and bridges will be decreased.

Floodwater damages immediately downstream of these structures will be virtually eliminated. Additional reductions of flood damages in the main stem floodplain area will be insignificant beyond those considered for land treatment measures normally used in the development of conservation plans.

Entry of pollutants in the form of sediment, nutrients (nitrates and phosphates), and animal wastes into the stream and reservoir system of the watershed will be greatly reduced. Water quality will be enhance.

Structural Measures

The combination of planned channel improvement and structural flood detention capacity will produce an overall reduction in evaluated flood damages of 42 percent. Crop and pasture damages will be reduced by 34 percent, non-agricultural damages by 66 percent, sediment damage by 48 percent, and indirect damage by 44 percent.

An estimated 160 agricultural landowners throughout the watershed, and a private channel recreation development on the Middle Fork will benefit directly from reduced floodwater damage. Following project installation 405 fewer acres will be flooded by the 100-year storm, 476 fewer acres by the 4-year storm, and 1,141 fewer acres by the annual storm. Benefits will accrue through increased agricultural production, reduced crop and pasture production costs, and reduced maintenance expenses on floodplain improvements.

Reduction of sedimentation of the Middle Fork Reservoir will preserve present water storage capacity for future use. A total annual reduction of 7.5 acre-feet per year will result from the project. Of this total, 7.2 acre-feet is due to Structure 4A and 0.3 acre-feet to land treatment. Reduction in this amount is comparable to a total storage capability increasing at the rate of 2.5 million gallons per year. A value of \$3,327 annually was placed on this damage reduction, \$3,194 of which is due to Structure 4A and \$133 to land treatment.

Whitewater Lake will benefit through reduced sedimentation afforded by the project. Sediment entering the lake with project will be reduced by an average of 5.5 acre-feet each year. Structure 23B will provide 3.9 acre-feet of this reduction and land treatment, 1.6 acre-feet. Such reduction will extend the useful life of approximately 60 acres of the lake for recreation use. An increased recreation opportunity averaging 10,700 visitor days annually will result. Value of the increased recreation opportunity was placed at \$12,015. Of this total \$8,555 is due to Structure 23B and \$3,886 to land treatment.

Reduction of sedimentation to Brookville Reservoir in the amount of 9.1 acre-feet per year will result from the project. Approximately 55 percent of this reduction will accrue through structural measures. The remaining 45 percent will stem from land treatment. Such reduction represents an opportunity to reappropriate for future beneficial use, a portion of present reservoir storage assigned to sediment. An annual value of \$670 was assigned to this benefit. Structural measures will contribute \$377 of this total and land treatment \$293.

No significant reduction of land damage caused by floodplain scour, stream-bank erosion, and gully is expected with the structural program. A feasible flood prevention structural program effective in reducing these damages in the watershed was unattainable.

In addition to the foregoing direct damage reductions, watershed residents and the general public will benefit from a reduction in indirect damages. Such benefits will be realized through a reduction in the number of flood events requiring traffic rerouting and work schedule interruptions.

Level of flood protection afforded by project structural measures will be greatest below Structures 23B, 28, 35 and 38. Generally a 50 to 100-year level of protection will be provided immediately below these structures. Such protection will decrease significantly within a distance of 2 to 3 miles downstream of each structure. Flood prevention downstream of Structure 4A will decrease from approximately a 2-year level immediately below the structure to a 1-year level in Reach B3 (see Project Map). Little damage reduction will occur on the main stem floodplain downstream of Richmond. Flood stages will be reduced 0.5 to 1.0 foot for all frequencies in this area.

Proposed channel improvement on the Middle Fork (Reach A5), from the vicinity of Glen Karn, Ohio, downstream will provide approximately a 1-year level of flood protection. No increases in flood stages are expected from

the terminus of the channel improvement to the pool area of Structure 4A. Planned channel improvements upstream of Glen Karn will provide solution to a joint flood-drainage problem occurring on 282 cropland acres. Increased depth for tile drainage and capacity for flood and drainage flows will enable local farmers to increase crop yields, reduce unit production costs, and improve crop quality. An annual increase in net income of \$2,969 is expected once on-farm improvements needed for the realization of project benefits have been installed.

Channel improvement on Baker Ditch (Reach A2) will provide nearly a 2-year level of flood protection to adjacent floodplain areas. No increases in flood stages are expected below the planned channel improvement. Construction of new ditch Lateral No. 1 will relieve a joint flood-drainage problem on 125 acres of cropland. Yields on presently cropped areas will enhance resulting in an increase in net income of \$1,343 annually.

Channel improvement on the East Fork (Reach D1-3) will provide an average of a 1 to 2-year level of flood protection. A slight increase in flood stages is expected immediately downstream of the upper segment of proposed channel improvement (Reach D3). Such stages will be limited to increases not to exceed 0.2 of a foot for the 10-year flood and larger, with no stage increases expected for the more frequent floods. Flood stages in the lower segment of channel improvement will be most reduced just south of the Preble County line. Flooding through the vicinity of New Paris will be slightly reduced with a decrease in flood stages of 0.5 to 1.0 foot for all floods.

Construction of East Fork Lateral No. 1 (Reach D4) will provide substantial relief to a critical joint flood-drainage problem occurring on

194 cropland acres in the New Madison vicinity. Relief of the problem will reduce greatly the risk of crop failure in the area and, in so doing, increase profitability. An increase in net income to the area of \$5,626 is expected with project.

Water stored for municipal and industrial water supply in Structures 4A and 8 will satisfy future municipal and industrial water supply needs at Richmond. An estimated 85,000 people will be served by 1990. This additional source will represent a 200 percent increase over present surface impoundment sources. Availability of an adequate water supply is closely linked with maintenance of economic stability and provision for growth within the area. Non-project provision of advanced waste treatment by the Richmond Sanitary District and installation of expanded sewage treatment facilities at Liberty are expected to relieve water quality problems on the East Fork.

As a result of recreation features included in the project, the general public will enjoy a variety of outdoor recreational activities. Facilities to be provided at Structure Sites 23B, 35 and 38 together with the channel recreation development downstream of Richmond will permit boating, swimming, water skiing, canoeing, picnicking, hiking, horseback riding, camping, and fishing. Heaviest use of these facilities is anticipated from Memorial Day and Labor Day with 238,700 annual visitations expected. The average weekend day visitation is expected to be about 4,200. An additional 47,300 visitor day of off-season recreation use is expected each year for a total annual use of 286,000 visitor days. Structure 23B is expected to receive 7 percent of the total annual use; Structure 35, 61 percent; Structure 38, 14 percent and the channel recreation development, the remaining 18 percent. The value per visitor day is estimated to be \$1.50.

In addition, it is the intention of local interests to use water stored in the combined sediment and water supply pools of Structure 4A and 8 for incidental recreation use will be limited primarily to fishing and non-power boating. An estimated 612 surface acres of water stored in these structures will provide an incidental recreation use of 31,000 visitor days annually at a net value of \$0.30 per visitor day. The sponsors will provide access to these two reservoirs and minimum sanitary facilities in accordance with State and local health regulations.

Because of the striking natural setting of the Whitewater Valley together with the scale of recreation development planned, it is conceivable that the recreation industry will play an important part in the future economy of the area. It has been estimated that 12 tourists each day throughout the year in a community will result in an income in the same proportion as that of an industry with a \$100,000 annual payroll.

The total water surface area planned in the five multiple purpose structures is 1,231 acres. These reservoirs will be available for public fishing in accordance with planned uses of the facilities. Over 1,500 acres will have limited uses around the reservoirs within the temporary flood pool limits. This will vary from limited farm operations in the flowage easement areas to "wild" land surrounding the permanent pools where land will be in public ownership. In addition, about 400 acres of land will be designated as wildlife areas in the areas purchased for recreation developments on the main channel and at Structures 23B and 35.

Increased demands on suppliers of local goods and services and on marketing, transportation, and processing facilities resulting from the project will expand commercial activity throughout the watershed.

The proposed project measures will cause an estimated 54 displacements due to land acquisition. These include 18 farm operations, 23 owner-occupied dwellings, 11 tenant-occupied dwellings and 2 mobile homes. A total of 85 owner-occupied persons and 51 tenant-occupied persons will be displaced. These displacements involve primarily rural areas surrounding the Richmond population center. The sponsors have determined that replacement housing is available within this same area. Farms are also available, although it is anticipated that some farm operations affected may not be replaced due to either the age or other interests of the owners.

The economic impact of lost farm operations is not expected to affect significantly the businesses or markets of the area due to the diversity of business and industrial enterprises within the Richmond area. The business opportunities generated by the advent of public recreation developments are expected to far exceed the lost farm income.

People will have the opportunity to relocate near the vicinity of their displacement, and they are expected to do so. Therefore, social ties will not be significantly affected.

Enhancement of the overall quality of environment in the watershed area will also occur making the watershed a more attractive and desirable place to work and live. Attraction of new industry and business into the area will result.

PROJECT BENEFITS

Total average annual benefits to the project are estimated at \$614,130. This includes off-site damage reduction benefits to land treatment measures of \$6,508 and benefits to structural measures of \$607,622 (Table 6). On-site conservation benefits to land treatment measures were not evaluated, as the worth of such measures is widely recognized.

Primary flood prevention benefits to structural measures were estimated as follows: damage reduction \$24,099 and more intensive land use \$9,261. Other primary benefits include drainage \$677, recreation \$429,000, municipal and industrial water supply \$70,000, and incidental recreation to water supply purposes \$9,300 (Table 6).

Damage reduction benefits accruing to the overall project include reduced crop and pasture damage of \$11,672, damage reduction to non-agricultural values of \$615, reduced sediment damage to existing or planned water storage reservoirs of \$16,012, and a reduction of indirect flood damage of \$2,308. Benefits of this type total \$30,607 (Table 5) and accrue jointly to the structural and land treatment programs. Evaluation of flood reduction benefits was limited to only those areas affected by project structural measures.

Local secondary benefits to structural measures were estimated at \$65,285 (Table 6). Only those benefits generated by the project through increased demands on local suppliers of goods and services and on local

processing, transporting, and marketing facilities were evaluated. Secondary benefits accruing through an enhancement of the overall environment of the watershed area, although significant locally, were not evaluated. Benefits of a secondary nature from a National viewpoint were not considered pertinent and were therefore not evaluated.

COMPARISON OF BENEFITS AND COSTS

Total project benefits to structural measures of \$607,622 annually compared to average annual structural cost of \$432,584 gives an overall benefit-cost ratio of 1.4:1.0. The ratio of primary project benefits to cost, excluding local secondary benefits in the amount of \$65,285 is 1.3 to 1.0.

PROJECT INSTALLATION

Land Treatment Measures

The sponsoring Soil and Water Conservation Districts will assume the responsibility for the application of the land treatment measures. The measures will be installed by private landowners and operators within an eight-year period. The Soil Conservation Service will provide personnel to assist the Soil and Water Conservation Districts in providing landowner and operators technical assistance to develop basic conservation plans and to install planned practices. Technical assistance for the woodland measures will be furnished by the Indiana Division of Forestry and the Ohio Division of Forestry and Reclamation in cooperation with the U. S. Forest Service.

The Whitewater Valley Conservancy District will assume responsibility for the installation of special land treatment measures. Project objectives cannot be achieved unless these special measures are installed within the eight-year land treatment installation period of the project. Current

financial assistance and private monies for major land treatment measures are not sufficient to accelerate this type of program. The sponsoring Soil and Water Conservation Districts in Indiana will assist in the implementing of this program. The measures will be installed over an eight-year period. The Soil Conservation Service will be responsible for the technical assistance necessary to implement the program.

Structural Measures

All works of improvement in Indiana will be installed during an eight-year period, and in Ohio the installation period will be four years. All land rights will be secured within a seven-year period in Indiana and within a three-year period in Ohio. However, on PL-566 cost shared improvements the land rights will be secured within a four-year period in Indiana. Actual alterations of roads and bridges may take place prior to or concurrently with the construction of the structural measures involved. Construction plans and specifications on contracts will be completed after the land rights are secured. In order to make efficient use of personnel and to realize the most benefits, the structural measures will be installed in the following sequence, by state and year after approval is indicated.

Indiana

1. No construction
2. Multiple Purpose Structure No. 23B and Recreation Facilities
Single Purpose Structure No. 28
3. Multiple Purpose Structure No. 35
4. South Recreation Facilities for Structure No. 35
5. Multiple Purpose Structure No. 8
North Recreation Facilities (partial) for Structure No. 35
6. North Recreation Facilities (completion) for Structure No. 35
7. Multiple Purpose Structure No. 4A
8. Channel Recreation Development and Facilities

Ohio

1. No Construction
2. East Fork Main (Preble Co.) and Middle Fork Main and Lateral No. 1 Channel Improvement
3. Multiple Purpose Structure No. 38 and East Fork Main and Lateral No. 1 (Darke Co.) Channel Improvement
4. Baker Ditch and Lateral No. 1 Channel Improvement
Recreation Facilities for Structure No. 38

The Whitewater Valley Conservancy District is the sponsoring local organization qualified under state law to carry out works of improvement outlined in the Indiana portion of this plan. The Conservancy District has the power of eminent domain and taxation, as provided by the Indiana Conservancy Act and will use this power as necessary to assure scheduled completion of the project. The Conservancy District will be responsible for securing land rights and administering contracts for the following structural works of improvement: Structures No. 8, 35, 4A, 23B and 28; Recreation development and facilities for Structures No. 35 and 23B and the channel recreation development. The Conservancy District will be responsible for obtaining the services of a consulting engineering firm for preparation of final recreation plans on Structures No. 35 and 23B, and on the channel recreation development below Richmond. The two multiple purpose water supply reservoirs (4A and 8) will be designed by negotiated A and E contract. The Conservancy District will be responsible for administering the A and E contracts and furnishing the local share of funds for design.

The Conservancy District will be responsible for those construction costs other than PL-566 allocated to recreation and municipal and industrial water supply on Structures No. 35, 23B, 4A and 8; recreation facilities on Structures No. 35 and 23B; and the channel recreation development.

Darke County and Preble County Commissioners, and the Jefferson Township Park District are the local sponsoring organizations qualified under Ohio State law to carry out the works of improvement outlined under the Ohio portion of this plan. The county commissioners and the park district have the power of eminent domain and taxation and will use this power as necessary to assure the scheduled completion of the project.

The Jefferson Township Park District will be responsible for obtaining land rights and for administration of contracts for Structure No. 38. The park district will be responsible for obtaining a consulting engineering firm for design of the final recreation site plan for Structure No. 38. The park district will also be responsible for those construction costs other than PL-566 allocated to recreation on Structure No. 38, and associated recreation facilities for that structure.

The Darke County Commissioners will be responsible for obtaining land rights, for administration of contracts, and for 50 percent of construction costs allocated to drainage for the channel improvement in that county.

The Preble County Commissioners will be responsible for obtaining land rights, for administration of contracts, and for 50 percent of construction costs allocated to drainage for part of East Fork Main channel improvement (Preble Co.), and a portion of the channel improvement on Baker Ditch.

The Soil Conservation Service will provide all engineering services for channel improvement in Ohio and for Structures No. 23B, 28, 35 and 38. Other Service participation in engineering services will involve cost sharing in negotiated architectural and engineering services contracts for Structures No. 4A and 8 and Recreation Facilities at Structure No. 23B, 38 and 35 South. The Service will provide administrative functions such as:

review of engineering plans prepared by others, construction layout and inspection of all works of improvement except Recreation Facilities for the channel and Structure No. 35 North. The Service also will provide administrative and engineering consultive assistance to others during the contracting and construction stages.

As a part of project administration the Sponsoring Local Organizations, qualified to carry out the works of improvement, will provide such relocation assistance advisory services as may be needed in connection with the relocation of displaced persons, business or farm operations. The sponsors will: (1) Provide personally or by first class mail, written notice of displacement and appropriate application forms to each displaced person, business or farm operation, (2) assist in filling applications, (3) review and approve applications for relocation assistance, (4) review and process grievances in connection with displacements, and (5) make relocation payments.

As a part of project administration, the Service will assist the sponsors in fulfilling their responsibilities in relocation assistance advisory services.

The sponsors have determined that decent, safe and sanitary replacement housing will be available for all persons subject to displacement by the project. Displaced persons will be given notice to vacate at least 90 days before they have to move.

As sponsors, the Soil and Water Conservation Districts in Union, Wayne, Randolph, Fayette Counties in Indiana and the Whitewater Valley Conservancy District will provide such assistance and guidance as necessary to facilitate the installation of the special land treatment measures as outlined in this plan.

The Departments of Natural Resources, States of Indiana and Ohio, in accordance with state laws and regulations will review and approve plans and specifications for the structural works of improvement to be constructed in each state.

FINANCING PROJECT INSTALLATION

Land Treatment Measures

Federal assistance for carrying out the works of improvement set forth in this plan will be provided under the authority of the Watershed Protection and Flood Prevention Act (PL-566, 83rd Congress, 68 Stat. 666) as amended. Federal financial assistance is contingent on the appropriation of funds to carry out this plan.

Technical assistance for installation of all accelerated land treatment for which the Soil Conservation Service has responsibility will be provided with PL-566 funds. Usual cost sharing for installation of these land treatment measures will be provided through the Rural Environmental Assistance Program and such special funds as might be appropriated by Congress. Financial assistance under the Rural Environmental Assistance Program (REAP) is not expected to be adequate for the planned accelerated land treatment program. Monies available through the Agricultural Conservation Program (ACP) in the past were not adequate to support such a costly land treatment program. Additional federal assistance for installation of special land treatment measures

will therefore be provided through PL-566 funds. Should federal cost share funds under other existing programs become available during any year of the installation period, PL-566 monies will be used during that year only to the extent necessary to supplement other federal funds.

This arrangement has been coordinated and cleared with the State Committee of the Agricultural Stabilization and Conservation Service (ASCS) in Indiana.

Cost sharing with federal funds will not exceed 50 percent of construction costs for the special measures, which have an estimated construction cost of \$670,800.

The Whitewater Valley Conservancy District will assume financial responsibility for the remaining 50 percent of construction costs on the special measures. Securing land rights for these measures will also be a responsibility of the District. Responsibility for installation of land treatment measures other than the special measures will be assumed by local farm owners and operators.

The total cost of installing land treatment measures for which the Forest Service has responsibility is estimated to be \$83,400. Of this amount technical assistance to private owners will cost \$40,800. This amount will be financed as follows: \$16,000 under PL-566, \$29,500 in Indiana for the combined State's share of the PL-566 accelerated program and Cooperative Forest Management Program, and \$4,300 in Ohio under the Cooperative Forest Management Program. The installation cost to private forest landowners is \$42,600 of which \$34,100 occurs in Indiana and \$8,500 in Ohio. It is expected that Rural Environmental Assistance Program cost sharing will be available to qualified private landowners for installation of these measures.

Structural Measures

All necessary land rights will be secured before Federal financial assistance is made available for the installation of the structural measures. These land rights include, but are not limited to, agreements, with county and state road officials concerning modifications to roads, and fee simple title or easements on land and improvements as required.

The sponsoring local organizations have analyzed their financial needs in consideration of the scheduled installation of the works of improvement and have made provisions for the ways and means of obtaining the necessary funds. The Whitewater Valley Conservancy District has submitted an application to Farmers Home Administration for a loan to help finance their share of project costs. They are presently exploring additional sources of funds that may be available through the Richmond Water Works Corporation. Other sources of funds being investigated are the Indiana Department of Natural Resources and the Bureau of Outdoor Recreation.

The Jefferson Township Park District has been formed in Preble County to sponsor the recreation at Structure No. 38. User fees will be required for operation and maintenance purposes at recreation developments No. 35 and No. 38. Estimated annual income for each facility is as follows:

<u>Item</u>	<u>No. 35</u>	<u>No. 38</u>
1. Beach Admission	\$35,547	\$11,025
2. Camping Fees	25,200	5,400
3. Boating Fees	7,680	873
4. Shelter House Reservations	-	70
5. Concession Profit	<u>14,000</u>	<u>1,787</u>
TOTAL	\$82,427	\$19,155

Users fees will not exceed that required to amortize the initial investment and provide for operation and maintenance.

The Whitewater Valley Conservancy District and the Preble and Darke County Commissioners, will be the legal entities through which the local people will carry out their responsibilities in the installation of the proposed works of improvement.

The Conservancy District will provide for the other than PL-566 funds on the installation of all works of improvement in Indiana. The Preble and Darke County Commissioners will provide for the other than PL-566 funds on the installation of the channel works of improvement in their respective counties. The Jefferson Township Park District will provide for other than PL-566 funds for recreation at Structure No. 38.

Invitations to bid on the construction of the planned structure measures will be issued after the project agreements are executed. These agreements will be executed when the following conditions have been met: PL-566 funds have been appropriated, the contracting agencies have funds available and are prepared to fulfill their responsibilities, necessary land rights have been obtained, necessary land treatment in the drainage area above the structural measures has been installed, construction plans and specifications have been prepared and approved as required, and operations and maintenance agreements have been executed.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment Measures

The land treatment measures will be operated and maintained by the owners and operators of the farms under agreement with the local Soil and Water Conservation Districts. Technical assistance will be provided by the Soil Conservation Service.

The special land treatment measures outlined in this work plan and cost shared with PL-566 funds will be operated and maintained by the Whitewater Valley Conservancy District with technical assistance furnished by the Soil Conservation Service.

Forest land treatment measures installed will be maintained by the landowners with technical assistance furnished by the Indiana Division of Forestry and the Ohio Division of Forestry and Reclamation, in cooperation with the U. S. Forest Service under the going Cooperative Forestry programs.

Structural Measures

Operation and maintenance cost include all necessary expenditures after installation to realize the estimated benefits during the project evaluation period.

The operation and maintenance work will consist of such items as repairing of all damage to structural embankments and spillways, mowing grass on embankments and emergency spillways, removing debris from the permanent pools, spraying or controlling of adverse vegetative growth within the channel and on channel side slopes, removing debris and/or excavation as required to reduce serious bank erosion, maintaining channel capacity, and repairing and replacing of recreation facilities. An equipment replacement schedule is included in preliminary recreation plans for each of the recreational developments.

Operation and maintenance of the recreational facilities will include such items as labor, utilities, insurance, maintenance supplies, and depreciation or replacement of facilities. The estimated replacement interval for items needing periodic replacement is as follows: garbage cans - 5 years; road and parking lot repairs - 10 years; signs, playground equipment and picnic tables - 17 years; fences, grilles, diving towers, swimming marker boundaries and guard chairs, boat docks and piers - 25 years; and buildings - 50 years.

The annual operation, maintenance and replacement cost for each recreation facility is as follows: Structure 23B - \$4,258; Structure 35 - \$52,100; Structure 38 - \$20,460; and Channel Recreation Development - \$6,075.

The Whitewater Valley Conservancy District will be responsible for the operation and maintenance of the structural works of improvement intalled within the State of Indiana. The Preble and Darke County Commissioners and Jefferson Township Park District will be responsible for the operations and maintenance of the works of improvement installed within their respective counties in the State of Ohio.

Operation and maintenance cost estimated for Indiana's works of improvement are estimated to be \$65,253 of which \$62,433 are for the operation and maintenance of recreation developments on Structures No. 35 and 23B, and the channel recreation area.

Operation and maintenance costs estimated for Ohio's works of improvement are estimated to be \$24,760 of which \$20,460 are for the multiple purpose Structure No. 38 recreation development.

A Soil Conservation Service representative will make a joint inspection with the sponsors annually, after severe floods, and after the occurrence of any unusual conditions that might adversely affect the structural measures. These joint inspections will continue for three years following the acceptance of the structure for operation and maintenance by the local sponsors. A report will be prepared of any such inspections making sure that the Service representative receives a copy. The State Department of Natural Resources will be informed of any scheduled inspections. A record of each inspection will be kept in the sponsor's file and will be available for authorized inspection.

Specific operations and maintenance agreements will be executed between the sponsors and the Soil Conservation Service prior to signing a land rights or project agreement. A fish and wildlife management plan for multiple purpose reservoirs and adjacent lands will be developed by the project sponsors with the assistance of the Indiana Division of Fish and Wildlife and the Ohio Division of Wildlife. Such plan will recognize alternate uses of the land and water and will minimize friction between users of these areas.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

East Fork of Whitewater River Watershed, Indiana-Ohio

Installation Cost Item	Unit	Number			Estimated Cost (Dollars) 1/				Total
		Non-Fed. Land (Indiana)	Non-Fed. Land (Ohio)	Total	PL-566	Other			
					Non-Fed. Land (Ind-Ohio)	Non-Fed. Land (Indiana)	Non-Fed. Land (Ohio)	Other Subtotal	
<u>Land Treatment</u>									
Soil Conservation Service									
Conservation Plan Measures									
Cropland	Ac.	49,640	14,515	64,155	-	1,034,690	929,783	1,964,473	1,964,473
Grassland	Ac.	13,219	3,910	17,129	-	525,665	90,300	615,965	615,965
Other Land	Ac.	2,698	2,790	5,488	-	63,185	30,244	93,429	93,429
Special Measures	No.	47	-	47	335,400	335,400	-	335,400	670,800
Technical Assistance	-	-	-	-	484,520	210,200	32,000	242,200	726,720
SCS Subtotal	xxx	65,557	21,215	86,772	819,920	2,169,140	1,082,327	3,251,467	4,071,387
Forest Service									
Forest Land	Ac.	3,990	670	4,660	-	34,100	8,500	42,600	42,600
Technical Assistance	-	-	-	-	16,000	20,500	4,300	24,800	40,800
FS Subtotal	xxx	3,990	670	4,660	16,000	54,600	12,800	67,400	83,400
Total Land Treatment	xxx	69,547	21,885	91,432	835,920	2,223,740	1,095,127	3,318,867	4,154,787
<u>Structural Measures</u>									
<u>Construction</u>									
Soil Conservation Service									
F.P. Structure	No.	1	-	1	46,400	-	-	-	46,400
M.P. Structures	No.	4	1	5	506,327	1,109,704	51,669	1,161,373	1,667,700
Structure Rec. Facilities	No.	2	1	3	448,472	722,768	142,135	864,903	1,313,375
Channel Recreation Deve-									
lopment	No.	1	0	1	-	255,750	-	255,750	255,750
Channel Improvement	Mi.	0	19.6	19.6	188,511	-	4,289	4,289	192,800
Subtotal Construction	xxx	xxx	xxx	xxx	1,189,710	2,088,222	198,093	2,286,315	3,476,025
<u>Engineering Services</u>									
Soil Conservation Service									
Subtotal Engineering					138,868	152,277	8,750	161,027	299,895
<u>Relocation Payments</u>									
Soil Conservation Service									
Subtotal Relocation Payments					53,440	109,420	11,790	121,210	174,650
<u>Project Administration</u>									
Soil Conservation Service									
Relocation Assistance						32,000	3,000	35,000	35,000
Advisory Services					-				
Construction Inspection					575,645				575,645
Other Cost					43,520	104,340	16,990	121,330	164,850
Subtotal Project Administration					619,165	136,340	19,990	156,330	775,495
<u>Other Costs</u>									
Land Rights					374,325	1,144,155	94,655	1,238,810	1,613,135
Subtotal Other					374,325	1,144,155	94,655	1,238,810	1,613,135
Total Structural Measures					2,375,508	3,630,414	333,278	3,963,692	6,339,200
TOTAL PROJECT					3,211,428	5,854,154	1,428,405	7,282,559	10,493,987
Summary									
Subtotal SCS					3,195,428	5,799,554	1,415,605	7,215,159	10,410,587
Subtotal FS					16,000	54,600	12,800	67,400	83,400
TOTAL PROJECT					3,211,428	5,854,154	1,428,405	7,282,559	10,493,987

1/ Price Base 1969

(Revised August 1971)

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

(At Time of Work Plan Preparation)

East Fork of Whitewater River Watershed
Indiana-Ohio

Measures	Unit	Applied to Date		Total Cost (Dollars) 1/	
		Indiana	Ohio	Indiana	Ohio
<u>Land Treatment</u>					
Basic Conservation Plan	No.	346	82	-	-
Conservation Cropping System	Ac.	62,840	12,685	-	-
Contour Farming	Ac.	61,067	5,269	12,048	1,053
Contour Strip Crop	Ac.	280	-	98	-
Critical Area Planting	Ac.	37	13	7,550	2,600
Crop Residue Use	Ac.	59,038	12,510	-	-
District Cooperators	No.	612	118	-	-
Ditch Bank Seeding	Ft.	133	-	2	-
Diversions	Ft.	66,700	10,220	23,345	10,220
Drainage Field Ditch	Ft.	-	12,000	-	2,400
Drainage Main or Lateral	Ft.	223,260	246,000	44,092	49,200
Farm Pond	No.	251	37	338,250	55,500
Field Border	Ft.	11	-	-	-
Fire Control	Ac.	28,417	4,633	28,400	4,600
Grade Stab. Structure	No.	129	-	38,700	-
Grass Waterway	Ac.	593	76	207,638	26,600
Hedgerow Planting	Ft.	7,000	2,600	350	130
Hydrologic Cultural Op.	Ac.	1,140	320	15,100	3,200
Minimum Tillage	Ac.	21,606	8,967	-	-
Pasture Management	Ac.	1,646	2,520	-	-
Pasture Planting	Ac.	11,600	582	464,000	23,280
Pasture Renovation	Ac.	1,074	445	42,960	17,800
Plow Plant	Ac.	250	-	-	-
Standard Soil Survey	Ac.	134,600	31,067	-	-
Spring Development	No.	135	6	67,750	3,000
Terraces	Ft.	49,750	10,000	17,413	3,500
Tile Drains	Ft.	1,616,313	2,468,000	565,719	863,800
Tree Planting	Ac.	237	43	14,200	2,600
Wildlife Habitat Mgt. & Dev.	Ac.	817	360	28,613	12,600
Woodland Grazing Control	Ac.	112	65	1,600	1,100
Subtotal	xxx	xxx	xxx	1,917,828	1,083,183
TOTAL	xxx	xxx	xxx	3,001,011	

1/ Price Base: 1969

March 1971

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

East Fork of Whitewater River Watershed, Indiana-Ohio

(Dollars) 1/

Item	Installation Cost P.L. 566 Funds					Installation Cost - Other Funds					Total Installation Cost
	Con- struction	Engi- neering	Land Rights	Relocation Payments	Total PL-566	Con- struction	Engi- neering	Land Rights	Relocation Payments	Total Other	
<u>MP Structures</u>											
4A	49,402	4,940	-	17,640	71,982	399,708	39,970	279,200	40,000	758,878	830,860
8	54,432	5,443	-	11,440	71,315	401,078	40,107	124,000	25,960	591,145	662,460
23B	151,724	26,180	15,325	2,230 1/	195,459	110,096	-	19,150	5,060 1/	134,306	329,765
23B Rec. Fac.	37,215	2,500	36,500	-	76,215	39,215	2,500	40,880	-	82,595	158,810
35	195,018	36,385	144,550	16,930 1/	392,883	198,822	-	157,650	38,410 1/	394,882	787,765
35 Rec. Fac. (North)	-	-	-	-	-	361,430	25,000	197,100	-	583,530	583,530
35 Rec. Fac. (South)	286,622	20,000	145,075	-	451,697	322,123	21,200	162,425	-	505,748	957,445
38	55,751	10,740	9,625	5,200 1/	81,316	51,669	-	10,205	11,780 1/	73,654	154,970
38 Rec. Fac.	124,635	8,750	23,250	-	156,635	142,135	8,750	26,010	-	176,895	333,530
<u>SP Structure</u>											
28	46,400	4,600	-	-	51,000	-	-	30,000	-	30,000	81,000
<u>MP Channels</u>											
EF Main	64,928	6,590	-	-	71,518	722	-	7,220	-	7,942	79,460
EF Lat. 1	33,725	3,410	-	-	37,135	375	-	43,480	-	43,855	80,990
MF Main	40,901	4,200	-	-	45,101	899	-	2,550	-	3,449	48,550
MF Lat. 1	18,689	1,910	-	-	20,599	411	-	2,550	-	2,961	23,560
Baker Ditch	29,186	3,100	-	-	32,286	1,814	-	2,190	-	4,004	36,290
Baker Lat. 1	1,082	120	-	-	1,202	68	-	450	-	518	1,720
<u>Channel Rec. Dev.</u>											
EFWW Main	-	-	-	-	-	255,750	23,500	133,750	-	413,000	413,000
Subtotal	1,189,710	138,868	374,325	53,440	1,756,343	2,286,315	161,027	1,238,810	121,210	3,807,362	5,563,705
Project Administration	XX				619,165	XX				156,330	775,495
GRAND TOTAL	XX				2,375,508	XX				3,963,692	6,339,200

1/ Price Base: 1969

2/ Engineering on MP Structures 4A and 8 and on recreation facilities 23B, 35 (South) and 38 to be contracted costs to be borne \$41,633 by P.L. 566 Funds and \$112,527 by Other Funds.

3/ Includes blanketing cost for M & I Water Supply purpose of \$40,000.

4/ Includes \$30,000 cost for rerouting Niewoehner Road across top of dam.

5/ Includes the following legal fees, survey costs, and costs for flowage easements:

	23B	23B Rec. Fac.	35	35 Rec. Fac. (South)	35 Rec. Fac. (North)	38	38 Rec. Fac.
Legal Fees and Survey Costs	1900	4380	4960	17,350	11,100	580	2760
Flowage Easements	1925	-	8140	-	-	-	-

6/ Relocation payments for displacements prior to July 1, 1972 will be shared as provided in P.L.-91-646 and in paragraph numbered 2 of the agreement.

7/ Relocation payments shown include the structure site and associated recreation facilities.

(Revised August 1971)

TABLE 2B - RECREATIONAL FACILITIES
ESTIMATED CONSTRUCTION COSTS

East Fork of Whitewater River Watershed, Indiana-Ohio

(Dollars) 1/

Items	Unit Cost	Structure Designation Number of Units			Construction Costs by Structure		
		35 (North)	35 (South)	38	35(North)2/	35(South)	38
<u>General</u>							
Remodel of bldgs.	5,000.00	1 Lump	-	-	5,000	-	-
Grading & seeding	200.00	100 ac.	200 ac.	40 ac.	20,000	40,000	8,000
Boundary fence	1.00	9,920 L. ft.	37,060 L. ft.	3,150 L. ft.	9,920	37,060	3,150
Entrance signs	Variable	1 Lump	1 Lump	1 Lump	750	1,250	1,000
Fishing pier	2,000.00	-	1 ea.	-	-	2,000	-
<u>Roads - Stone, Oil & Chip</u>							
Main Entrance	9.60	800 L. ft.	350 L. ft.	400 L. ft.	7,680	3,360	3,840
Interior	Variable	4,000 L. ft.	10,350 L. ft.	3,700 L. ft.	32,000	82,800	26,720
Culverts	Variable	1 Lump	1 Lump	1 Lump	5,000	15,000	2,000
Campground loops	4.80	8,200 L. ft.	-	1,700 L. ft.	39,360	-	8,160
Camping spurs & service drives	2.00	9,000 L. ft.	3,200 L. ft.	1,500 L. ft.	18,000	6,400	3,000
Trails	500.00	2.5 mi.	6.75 mi.	2 mi.	1,250	3,375	1,000
<u>Swimming</u>							
Bath house	Variable	-	1 ea.	1 ea.	-	40,000	30,000
Sand Beach	.50	-	65,000 S. ft.	18,000 S. ft.	-	32,500	9,000
Diving tower	Variable	-	1 ea.	1 ea.	-	6,000	5,000
Beach equip.	Variable	-	1 Lump	1 Lump	-	1,900	1,350
Beach fence	3.50	-	1,200 L. ft.	700 L. ft.	-	4,200	2,450
Parking area oil & chip	.40	-	70,000 S. ft.	25,500 S. ft.	-	28,000	10,200
<u>Boating</u>							
Boat ramp	Variable	1 ea.	-	1 ea.	7,500	-	2,000
Mooring boat docks	125.00	60 ea.	-	20 ea.	7,500	-	2,500
Boat docks	750.00	1 ea.	1 ea.	-	750	750	-
Boat house	2,500.00	1 ea.	-	-	2,500 ^{5/}	-	-
Parking area oil & chip	.40	55,500 S. ft.	-	15,600 S. ft.	22,200	-	6,240
<u>Camping</u>							
Campsites ^{3/}	120.00	180 ea.	-	30 ea.	21,600	-	3,600
Shower bldg. ^{4/}	Variable	2 ea.	-	1 ea.	47,000	-	17,500
Sanitary dump- ing station	1,000.00	1 ea.	-	1 ea.	1,000	-	1,000
Electric Conn.	100.00	180 ea.	-	30 ea.	18,000	-	3,000
Parking area oil & chip	.40	12,000 S. ft.	-	1,800 S. ft.	5,040	-	720
Playground equip.	Variable	1 Lump	-	1 Lump	10,000	-	2,000

TABLE 2B - RECREATIONAL FACILITIES
ESTIMATED CONSTRUCTION COSTS

Items	Unit Cost	Structure Designation Number of Units			Construction Costs by Structure		
		35 (North)	35 (South)	38	35(North)	35(South)	38
<u>Picnicking</u>							
Shelter house w/toilet	12,500.00	-	2 ea.	1 ea.	-	25,000	12,500
Shelter house	6,000.00	-	1 ea.	-	-	6,000	-
Flush toilets	5,000.00	-	1 Lump	1 Lump	-	5,000	5,000
Picnic tables	40.00	-	120 ea.	50 ea.	-	4,800	2,000
Grills or ovens	40.00	-	24 ea.	10 ea.	-	960	400
Garbage stations	30.00	-	30 ea.	12 ea.	-	900	360
Playground equip.	Variable	-	1 Lump	1 Lump	-	10,000	4,000
Parking area oil & chip	.40	-	45,000 S. ft.	15,000 S. ft.	-	18,000	6,000
<u>Remote Picnic Area</u>							
Vault toilet	4,000.00	-	1 Lump	-	-	4,000	-
Mooring posts	15.00	-	10 ea.	-	-	150	-
Picnic tables	40.00	-	12 ea.	-	-	480	-
Grills	40.00	-	3 ea.	-	-	120	-
Garbage stations	30.00	-	3 ea.	-	-	90	-
Pier	300.00	-	1 ea.	-	-	300	-
<u>Sports</u>							
Baseball diamond	1,500.00	-	1 ea.	-	-	1,500 ^{5/}	-
Basketball court	8,000.00	-	1 ea.	-	-	8,000 ^{5/}	-
Tennis court	4,000.00	-	2 ea.	-	-	8,000 ^{5/}	-
Parking area oil & chip	40.00	-	9,000 S. ft.	-	-	3,600	-
<u>Water System</u>							
Water Main from city	3.50	-	13,500 L. ft.	-	-	47,250	-
Dist. System	Variable	12,950 L. ft.	22,550 L. ft.	6,500 L. ft.	12,460	20,215	6,850
Water stations	250.00	-	5 ea.	3 ea.	-	1,250	750
Pumping stations	12,000.00	-	-	1 ea.	-	-	12,000
<u>Sewerage System</u>							
Sewer (8")	6.00	3,700 L. ft.	8,800 L. ft.	2,800 L. ft.	22,200	52,800	16,800
Man holes	340.00	12 ea.	30 ea.	9 ea.	4,080	10,200	3,060
Lift station	Variable	-	1 ea.	1 ea.	-	12,000	8,000
Force main (6")	2.50	-	7,000 L. ft.	2,500 L. ft.	-	17,500	6,250
Sewer Conn. for campsites	50.00	40 ea.	-	-	2,000	-	-
<u>Electrical System</u>							
Underground elec. system	10,000.00	1 Lump	-	-	10,000	-	-
1/ Price Base: 1969					Subtotal Construction	332,790	562,710
2/ Excluded from P.L. 566 cost sharing due to excess of allowable P.L. 566 rec. cost.					Construction Contingencies	16,640	28,035
3/ Includes: tables, grills, garbage stations and water taps.					Expendable Equip. ^{5/}	12,000	18,000
4/ Includes flush toilets and central showers					Total Const. Cost	361,430	608,745
5/ Non cost-share items					Items Ineligible for P.L. 566 Cost Share	361,430	35,500
					Eligible P.L. 566 Cost Share Items	-	573,245
							249,270

TABLE 2B - RECREATIONAL FACILITIES
ESTIMATED CONSTRUCTION COSTS

East Fork of Whitewater River Watershed, Indiana-Ohio

(Dollars) 1/

Items	Unit Cost	Structure Designation Number of Units		Construction Costs by Structure	
		23B	Channel Rec. Dev.	23B	Channel Rec. Dev. <u>2/</u>
<u>General</u>					
Grading & seeding	200.00	60 ac.	-	12,000	-
Clearing & grading for trails & park areas	20,000.00	-	1 Lump	-	20,000
Boundary fence	1.00	3,300 L. ft.	-	3,300	-
Entrance signs	Variable	1 Lump	1 Lump	750	2,500
Debris removal & site dev.	Variable	-	1 Lump	-	62,480
Fishing pier	2,000.00	1 ea.	-	2,000	-
<u>Roads - Stone, Oil & Chips</u>					
Main Entrance	8.00	700 L. ft.	-	5,600	-
Interior	6.40	1,650 L. ft.	-	10,560	-
Concrete fords	20,000.00	-	1 Lump	-	20,000
Parking lots	.40	46,000 S. ft.	120,000 S. Ft.	18,400	48,000
<u>Boating</u>					
Boat ramps	1,000.00	1 ea.	4 ea.	1,000	4,000
Mooring Posts	15.00	20 ea.	-	300	-
<u>Picnic Area</u>					
Shelter house	Variable	1 ea.	4 ea.	5,000	32,000
Vault toilets	4,000.00	1 ea.	4 ea.	4,000	16,000
Picnic tables	40.00	32 ea.	100 ea.	1,280	4,000
Grills or ovens	Variable	6 ea.	20 ea.	300	800
Garbage stations	30.00	8 ea.	24 ea.	240	720
Playground equip.	Variable	1 ea.	4 ea.	3,000	10,000
Well & water sta.	Variable	1 ea.	4 ea.	3,250	12,000
<u>1/ Price Base: 1969</u>				Subtotal Construction	70,980
<u>2/ Excluded from P.L. 566 cost</u>				Construction Contingencies	3,450
sharing due to excess of rec.				Expendable equipment	2,000
dev. eligible for cost sharing				Total Construction Cost	76,430
<u>3/ Non cost-share items</u>				Items Ineligible for Cost	-
				Sharing	2,000
				Eligible Cost Share Items	74,430
					232,500
					23,250
					-
					255,750
					255,750
					-

TABLE 3 - STRUCTURE DATA
FLOODWATER RETARDING STRUCTURES AND WATER SUPPLY RESERVOIRS

East Fork of Whitewater River Watershed, Indiana-Ohio

Item	Unit	Structure Number						TOTAL
		4A	8	35	23B	38	28	
Class of Structure		c	c	c	c	c	c	
Drainage Area	Sq. Mi.	25.4	19.6	12.9	9.0	1.1	2.7	70.7
Curve No. (1-day) (AMC II)		77	78	77	77	73	75	
To	Hrs.	6.7	4.5	3.4	4.6	1.5	1.0	
Elevation Top of Dam	Ft.	1122.7	1005.8	1096.4	999.7	1120.7	914.7	
Elevation Crest of Vegetated Spillway	Ft.	1118.4	1000.2	1089.9	992.2	1114.5	907.0	
Elevation Crest High Stage	Ft.	1114.0	995.0	1085.0	981.0	1110.5	893.3	
Elevation Crest Low Stage	Ft.	1112.0	993.0	-	-	-	-	
Maximum Height of Dam	Ft.	50	58	52	64	54	30	
Volume of Fill	Cu. Yds.	338,000	234,000	392,000	366,000	142,500	47,000	1,519,500
Total Capacity	Ac. Ft.	6,234	4,038	9,800	3,270	647	600	24,589
Sediment Submerged	Ac. Ft.	1,250	624	417	726	78	103	3,198
Sediment Aerated	Ac. Ft.	175	90	48	108	-	101	522
Beneficial Use - Water Supply	Ac. Ft.	4,070	2,932	-	-	-	-	7,002
Beneficial Use - Recreation	Ac. Ft.	-	-	6,633	1,024	436	-	8,093
Floodwater P.S. Hydrograph above High Stage	Ac. Ft.	739	392	2,702	1,412	133	396	5,774
Surface Area								
Sediment Pool	Acres	147	76	85	61	9	17	
Beneficial Pool - Water Supply	Acres	423	189	-	-	-	-	
Beneficial Pool - Recreation	Acres	-	-	474	113	32	-	
Retarding Pool	Acres	505	207	585	162	36	62	
Principal Spillway (100 Year Frequency)		c	c	c	c	c	c	
Hydrograph								
Rainfall Volume (areal) (1-day)	In.	5.61	5.68	5.70	5.84	5.75	5.84	
Rainfall Volume (areal) (10-day)	In.	9.99	10.08	10.03	10.21	10.06	10.21	
Runoff Volume (10-day)	In.	5.00	5.25	3.22	3.34	4.36	4.82	
Capacity of Low Stage	cfs	437	437	-	-	-	-	
Capacity of High Stage	cfs	11,132	13,975	390	216	74	57	
Frequency Operation - E. Spillway	% chance			1	1	1	1	
Size of Conduit	Diam. - In			48	36	30	30	
Type of Principal Spillway		Chute	Chute	Drop Inlet	Drop Inlet	Drop Inlet	Drop Inlet	
Low Stage Weir Length	Ft.	50	50	-	-	-	-	
High Stage Weir Length	Ft.	300	300	22.3	16.3	15	15	
Maximum Water Surf. Elev.	Ft.	1116.3	997.7	1089.9	992.2	1114.5	907.0	

TABLE 3 - STRUCTURE DATA - cont'd
FLOODWATER RETARDING STRUCTURES AND WATER SUPPLY RESERVOIRS

East Fork of Whitewater River Watershed, Indiana-Ohio

Item	Unit	Structure Number						Total
		4A	8	35	23B	38	28	
Emergency Spillway Hydrograph								
Rainfall Volume	In.	9.06	8.90	9.51	9.75	9.67	9.75	
(ESH) (areal)	In.	6.21	6.28	6.67	6.90	6.32	6.65	
Runoff Volume (ESH)				Veg.	Veg.	Veg.	Veg.	
Type		Chute	Chute	600	400	100	200	
Bottom Width	Ft.	-	-	6.2	7.22	6.07	6.80	
Velocity of flow (Ve)	Ft./Sec.	-	-	.022	.020	.030	.019	
Slope of Exit	Ft./Ft	-	-					
Channel								
Maximum Water								
Surface Elev.		1118.4	1000.2	1091.9	995.0	1116.5	909.5	
Freeboard Hydrograph								
Rainfall Volume								
(FH) (areal)	In.	23.40	23.00	25.05	25.50	25.50	25.65	
Runoff Volume (FH)	In.	20.14	19.91	21.79	22.40	21.54	22.04	
Vegetated Spillway	Ft.	800	600	-	-	-	-	
Maximum Water Sur-								
face Elevation	Ft.	1122.7	1005.8	1096.4	999.7	1120.7	914.7	
Capacity Equivalents								
Sediment Volume	In.	1.05	.68	.68	1.74	1.30	1.42	
Retarding Volume	In.	.73	.41	3.68	2.95	2.30	4.00	

Table 3A- STRUCTURE DATA

CHANNELS

East Fork of Whitewater River Watershed, Indiana-Ohio

Name & Reach	Sta. to Sta.		Drain. Area Sq. Mi.	Capacity CFS		Water Surface Elev.	Hydr. Grad. (ft/ft)	Channel Dimensions			"n" Value2/		Velocities		Type/ of Imp.	Excav. Cu. Yds.
	Head	Foot		Reqd.	Dsgn			Btm. (ft)	Dpt. (ft)	Excav. S. Slps	Aged	As Blt	Aged	As Blt		
Middle Fork Reach (A5)	242+00		1.1	140	140	1151.0	.0012	4	7.0	2:1	.04	.030	2.67	3.11	C&CE	9000
		299+00	3.2	300	350	1144.2				2:1	.04	.030	3.09	4.13	C&CE	
	299+00		3.2	300	450	1144.2				-	.04	.035	3.26	3.71	C&SR	
		337+00	4.3	410	450	1139.6		4		-	.04	.035	3.26	3.71	C&SR	
	337+00		6.8	650	658	1139.6		10		-	.0375	.0325	3.65	4.2	C&SR	
		402+00	8.0	650	658	1131.8				-	.0375	.0325	3.65	4.2	C&SR	
	402+00		8.0	650	656	1131.8			2:1	.035	.030	3.72	4.4	C&CE		
		432+50	11.8	650	656	1128.1			2:1	.035	.030	3.72	4.4	C&CE		
	432+50		11.8	650	660	1128.1				-	.035	.030	3.8	4.5	C&SR	
	447+00	12.9	650	660	1126.4	.0012	10	7.0	-	.035	.030	3.8	4.5	C&SR		
Stap. Ditch Reach (A5)	168+00		.4	70	84	1176.0	.0036	4	5.0	2:1	.04	-	3.05	-	CE	19000
		232+00	.6	80	84	1153.0	.0036			2:1	-	-	3.05	-	CE	
	232+00		.6	80	92	1153.0	.0016			2:1	-	-	2.35	-	C&CE	
		252+00	.7	90	92	1149.8	.0016	4	5.0	2:1	.04	-	2.35	-	C&CE	
Baker Ditch Reach (A2)	559+00		.5	75	88	1105.0	.0046	4	4.0	2:1	.04	-	3.4	4.2	C&CE	3000
		591+20	.9	110	108	1090.0	.0046	4	4.0	2:1	.04	-	3.6	-	C&CE	
	591+20		.9	110	129	1090.0	.0021	4	4.0	-	.04	.035	2.7	3.1	C&SR	
		652+00	1.6	200	205	1077.0	.0021	4	4.8	-	.04	.035	3.2	3.6	C&SR	
	652+00		2.6	250	267	1077.0	.0018	6	5.0	-	.04	.035	3.4	3.9	C&SR	
	747+50	3.4	280	267	1059.8	.0018	6	5.0	-	.04	.035	3.4	3.9	C&SR		
Baker Ditch Lat. 1 Reach (A2)	575+20		.3	60	92	1097.3	.0045	4	4.0	2:1	.04	-	3.4	-	CE	
		585+20	.5	75	98	1092.8	.0045	4	4.0	2:1	.04	-	3.4	-	CE	
East Fork Main Reach (D3)	330+30		3.0	300	369	1089.4	.0028	4	6.0	-	.04	.035	4.1	4.9	C&SR	9000
		345+30	3.0	300	369	1085.2	.0028	4	6.0	-	.04	.035	4.1	4.9	C&SR	
	345+30		6.0	440	405	1085.2	.0011	8	6.0	-	.04	.035	3.2	3.7	C&SR	
		349+50	6.0	440	405	1084.7	.0011	8	6.1	-	.04	.035	3.2	3.7	C&SR	
	349+50		6.0	440	441	1084.7	.0011	8	6.1	2:1	.0375	.030	3.5	4.3	C&CE	
		395+30	8.0	520	517	1079.7	.0011	8	6.8	2:1	.0375	.030	3.5	4.3	C&CE	
	395+30		8.0	520	517	1079.7	.0011	8	6.8	-	.0375	.035	3.5	3.9	C&SR	
		417+30	9.0	560	554	1077.3	.0011	8	7.0	-	.0375	.035	3.5	4.0	C&SR	
	417+30		10.2	620	640	1077.3	.0014	10	7.0	-	.0375	.035	3.8	4.2	C&SR	
		459+00	14.3	700	690	1071.5	.0014	10	7.0	-	.0375	.035	4.1	4.5	C&SR	
	459+00							NO WORK								
		572+50	17.4	900	965	1056.6	.0013	20	6.0	2:1	.035	.03	4.2	4.9	C&CE	
	645+50	19.64	960	965	1047.2	.0013	20	6.0	2:1	.035	.03	4.2	4.9	C&CE		
	645+50	21.00	960	1030	1047.2	.0033	20	6.0	-	.0375	.035	5.6	6.1	C&SR		
Reach (D2)		707+50	22.00	960	1030	1026.6	.0033	20	6.0	-	.0375	.035	5.6	6.1	C&SR	30000
	707+50		23.00	1020	1020	1026.6	.0015	30	6.0	-	.04	.04	4.1	4.5	C&SR	
		765+50	24.00	1020	1020	1017.9	.0015	30	6.0	-	.04	.04	4.1	4.5	C&SR	
	765+50		33.00	2240	2240	1017.9	.0025	-	-	-	.04	.04	5.1	5.1	C	
		810+50	34.00	2240	2240	1006.4	.0025	-	-	-	.04	.04	5.1	5.1	C	
	810+50		36.00	2240	2240	1006.4	.0025	-	-	-	.04	.04	5.1	5.1	C	
		882+00	37.61	2360	2360	988.5	.0025	-	-	-	.04	.04	5.6	5.6	C	
East Fork Lat. 1	238+00		.5	80	216	1089.6	.0008	4	6.0	2:1	.04	-	2.2	-	CE	41000
		269+00	1.0	160	216	1087.1	.0008	4	6.0	2:1	.04	.025	2.2	3.6	CE	
	269+00		1.0	160	174	1087.1	.00025	8	6.0	2:1	.04	.025	1.4	2.2	CE	
		345+30	1.8	180	174	1085.2	.00025	8	6.0	2:1	.04	.025	1.4	2.2	CE	

1/ Channel Improvement Symbols

C - Clearing Woody Vegetation in channel
C&SR - Clearing Woody Vegetation & Shoal RemovalC&CE - Clearing Woody Vegetation on one slope; excavate bottom & other slope
CE - Channel Excavation

2/ Indicates weighted "n" Value

March 1971

TABLE 4 - ANNUAL COST

East Fork of Whitewater River Watershed, Indiana-Ohio

(Dollars) 1/

Evaluation	Amortization of Installation Cost <u>2/</u>	Operation and Maintenance Cost	Total
- All Structures, Structure Rec. Developments, and Channel Rec. De- velopment	286,041	86,153 <u>3/</u>	372,194
- All Channel Improve- ment: East Fork, Middle Fork, and Baker Ditch	14,622	3,860	18,482
Project Ad- ministration	41,908	XXXXXXXXXXXXX XXXXXXXXXXXXX	41,908
GRAND TOTAL	342,571	90,013	432,584

1/ Price Base: Installation, 1969; 0, M&R, Adjusted Normalized (April 1966).2/ 100 years @ 5 3/8 percent interest.3/ Includes \$76,818 for operation, maintenance, and replacement for the MP Structure recreational developments and \$6,075 for the channel recreational development.

Revised August 1971

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

East Fork of Whitewater River Watershed, Indiana-Ohio

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefit
	Without Project	With Project	
Floodwater			
Crop and Pasture	33,861	22,189	11,672
Non-Agricultural	930	315	615
Subtotal	34,791	22,504	12,287
Sediment Reservoirs	33,494	17,482	16,012
Indirect	5,228	2,920	2,308
TOTAL	73,513	42,906	30,607

1/ Price Base: Adjusted Normalized (April 1966).

March 1971

I N V E S T I G A T I O N S A N D A N A L Y S E S

This section describes the type and intensity of the investigations and analyses which were made in formulating and evaluating the project. It describes the scope and intensity of surveys and investigations and the methods used in analyzing and interpreting the basic watershed data in order to determine the physical and economic feasibility of the project. The material is presented under the following appropriate headings.

LAND TREATMENT

Basic data for watershed land use and treatment under the going and accelerated programs were prepared by the sponsoring Soil and Water Conservation Districts with assistance from local Soil Conservation Service employees. Procedure utilized in developing the data began with a listing of predominate watershed soils by capability class, sub-class, and unit. Soils having similar use capabilities, treatment needs, and hydrologic characteristics were combined into soils groups.

Present and anticipated future "with project" use and treatment of soils within each grouping were then determined. Resources employed in this determination included Conservation Need Inventories, Land Resource Area Maps, soil surveys, basic conservation plans, and the considerable knowledge of local leaders familiar with the watershed.

Preliminary locations of structural measures to be included in the special measures portion of the accelerated land treatment program were made by members of the Whitewater Valley Conservancy District with the assistance of local Soil Conservation Service employees. Selection of sites was based primarily on existing damages and present land use at each location. Such locations were reviewed by the Watershed Planning

Staff of the SCS. Those proposed structural measures which were found to be either physically restricted by storage requirements or site limitations, excessively costly in terms of drainage area controlled, or conflicting with other planned or potential uses of the site were screened. The combined judgment of the Planning Staff was primarily relied upon in the screening process.

Once finalized, the land use and treatment data provided the basis for estimation of "with" and "without project" runoff and erosion in the watershed. In so doing an analytical framework was established within which watershed problems and effects of structural improvements could be studied.

A measure of the scope of the presently applied land treatment program within the watershed as well as the accelerated program to be applied is presented in Table 1A and the land treatment portion of Table 1, respectively.

HYDRAULICS AND HYDROLOGY

The watershed was analyzed using procedures outlined in the National Engineers Handbook, Section 4, Hydrology. This analysis was used to help design the structural works of improvement and for the economic evaluation.

Resource Material

Basic data used for these studies were engineering field surveys, USGS topographic maps and water supply papers, aerial photographs and other material. This included soils and land use information from the District Conservationists. The Richmond Water Works, the Richmond Sanitary District and the Corps of Engineers also provided information pertinent to this work plan.

Several personal visits to the watershed were made by the hydrologist and his technician to ascertain the natural hydrologic features and damage areas, to confer with agency people and local interested citizens, and to outline surveys.

Field surveys were made at 50 valley sections, 40 bridges, 28 potential dam sites, and 48 channel sections at other locations. Flood damage areas were outlined on maps by interview with knowledgeable local residents. Other physical data was taken from USGS 7 $\frac{1}{2}$ ' quadrangle sheets.

Land Use and Treatment Considerations

Land use and treatment data for With Project Condition was used to calculate Runoff Curve Numbers for use by the engineer in structure designs. The land use and treatment anticipated for the With Project Condition showed a two Curve Number reduction from the Without Project Condition. This improved hydrologic condition alone is expected to reduce peak stream flows by an average of nine percent.

The special land treatment measures planned as a part of this watershed project were not deemed effective in altering flood peaks in major main stream channels. Judgment was used in arriving at the physical effects these structures will have in the immediate downstream tributary channels and associated floodplains.

Time of Concentration

The hydrologic factor T_c was found for local runoff areas principally by use of the SCS nomograph 3-L-45007. The exceptions were for the flatter areas where T_c was calculated by the velocity-travel length method.

Frequency Analysis

A study of the rain gage records at Greenville, Ohio, and Richmond, Indiana, showed that the 24 hour synthetic rainfall Table No. 1 would represent the rainfall which commonly causes floods on the East Fork of Whitewater River. Rainfall depths by frequency were taken from Weather Bureau Technical Paper No. 40 for 24 hour duration. Rainfall depths for events more frequent than the one-year event were found by straight line extension of rainfall-frequency curves plotted on semi-log paper. Area depth correction for areas larger than 10 square miles was done by the curve published in Figure 15, TR-40. Frequency studies were conducted on the all-year basis. The monthly distribution of flood events was obtained from a study of Indiana, Illinois and Ohio stream gage records. This distribution was provided the economist. January through December percentages are: 12, 14, 16, 14, 11, 10, 8, 3, 2, 2, 3 and 5.

Extensive studies were made of the stream gage records at Richmond and Brookville on the East Fork of the Whitewater River and at Alpine and

Brookville on the Whitewater River. The gage at Abington on the East Fork has such a short record it was not considered for frequency study.

The existing Middle Fork Reservoir of the Richmond Water Works was assumed to have affected the peak flow regime at the Richmond stream gage. A double mass curve analysis of this gage record with other Whitewater Basin gage records showed a definite 30% reduction in the annual peaks at the Richmond gage following the installation of this reservoir in 1960.

The peak flow studies at this gage were then completed using 70% of the peaks recorded in the Water Supply Papers for the record prior to the 1961 water year.

The partial duration plot of the Richmond stream gage established the peak-frequency relation very well for frequent events. Several other methods were used to find the peak discharge of the 100 year event. Calculations by log Pearson Type III and the Computing Method in Chapter 18 of NEH for annual series gave good estimates of the 100 year peak. However, the 100 year peak which best fit the partial duration curve (and had substantial analytical backing) came from the 1% value on a curve on log-normal paper found by plotting and rectifying the annual series recorded. By this analysis, the largest flood at Richmond (January 1959) since the 17 year record began would rate as a 10 year event.

The Volume-Frequency relationship for the Richmond stream gage was taken from the 1967 SCS Partial Duration Studies of Selected Indiana Stream Gages. For the Richmond Gage these are 2-day runoff volumes. This study did not consider that the last 6 years of the 17 year record are biased by the Middle Fork Reservoir. Double Mass Curve analysis of this gage compared with the other Whitewater Basin gages shows that 2-day runoff

is 17% less than before the reservoir was constructed. This would indicate that the 2-day volumes published in the above mentioned 1967 report are too high for the present situation and too low for the former situation. However, the assumption that 2-days is the proper length of time to consider for volume is somewhat rough. A study of flood hydrographs for the years 1962-1967 reveals that the average flood flow duration is now a little greater than two days. Before construction of the Middle Fork Reservoir, the typical flood duration was considered to be slightly less than two days. Thus, a mix of the record before and after the Reservoir gives a usable Run-off Volume-Frequency relationship at Richmond.

The Runoff Volume-Frequency relation at Richmond was compared with area corrected TP-40, 24 hour Rainfall-Frequency data. This comparison provided a scale of Runoff Curve Numbers based on frequency. These Curve Numbers by frequency were used for Without Project Conditions as the relation between rainfall and storm runoff for all size drainage areas within the watershed. For With Project Condition the Curve Numbers were reduced by two in accord with the projected land use and treatment. A chart of Runoff Depth by Drainage Area by Percent Chance was prepared for both Without Project and for With Project Conditions. These depths became the Q at which peak discharge, q , was read from Q vs q curves (plotted from the TR-20 output) to place in the Ecomonics FREQ-FLOW input.

Hydraulic Studies

Eight Water Surface Profiles were run by the ADP hydraulics program for both Without Project and With Project Conditions. The profiles were started at the Brookville Reservoir with water surface elevations from the Corps of Engineers frequency of storage utilization curve. The starting CSM were assumed on the basis of regionalized peak-frequency data

calculated for the Whitewater Basin. At a few sections alterations were made manually in the rating curves to reflect minor changes in channel design following the With Project Profiles. Ratings from this program agree well with the published USGS ratings at the Richmond and Abington Stream gages. Punched cards of output data from this program giving discharge, cross section area and acres flooded by stage were utilized by the Hydrology and Economics computer programs.

Flood Routings

The flood routing was done by computer using TR-20 procedure. The Middle Fork Reservoir and Whitewater Lake on Silver Creek were included in the routing model. Middle Fork Reservoir was assumed to be in its second stage of development with the pool at 985' m.s.l. Three runoff depths (0.5", 2.0" and 4.0") were routed for the Without Project Condition (Alternate No. 2) and for each of three With Project Conditions. The three With Project Conditions were: channel improvement only (Alternate No. 3), channel improvement plus 13 major structures (Alternate No. 4) and channel improvement with but 5 major structures (Alternate No. 5). Structures included in Alternate No. 5 were numbered 4A, 8, 23B, 35 and 38. The structure designs in this work plan are the same as those used in flood routings.

Hydrologic Effects

Peak discharges, q , were plotted versus runoff depths, Q . Likewise, water surface elevations were plotted versus runoff. These graphs were made for each evaluation section for each alternate. Using the Runoff Depth by Drainage Area by Percent Chance Data developed under Frequency Analysis it was possible to read Peak-Frequency and Elevation-Frequency

information from these charts. Peak and elevation reductions from Land Treatment alone were readily observed.

Confidence in the Without Project routings is enhanced by their close agreement with historical gage and interview information and with the peak-volume relation for this watershed. As the same routing model was used for the With Project routings, equal confidence in the claimed physical effects of the project is assured.

Physical flood damage reduction below Structure No. 28 was determined by relating this site to other sites studied with like hydrologic characteristics and similar control.

Area Flooded

Flood lands were located on USGS quad sheets from which these areas were planimetered by reach as assigned to individual cross sections for evaluation. The area outlined was considered to represent a 100 year flood. Channel area was subtracted and the remainder compared with the 100 year flooded area recorded on the water surface profile output. This ratio was placed on the cross section header card for the Economics Program.

ENGINEERING

Engineering studies leading to final structural formulation involved consideration of a number of alternate designs on individual structure sites and channel improvements, as well as various combinations of structure and channel alternates.

Structures

Basic data used in the structural evaluations and design were obtained from U. S. Geological Survey topographic maps, aerial photographs, field

surveys, geological investigations, and field observations. Road profiles and centerline surveys of structure sites were used to verify the accuracy of the USGS topograph maps. Additional basic data included a complete topographic map of Structure No. 35 prepared by use of photogrammetric methods, a partial topographic map of Structure No. 8 prepared by the City of Richmond, and a topographic map of Structure No. 4A prepared by field survey, several road profiles, and cross sections in conjunction with USGS topographic maps. The basic data developed in the planning stage for Structure No. 35 should be of sufficient accuracy to be used in final design.

Stage storage curves were developed for each structure. Runoff Curve Numbers and Times of Concentration were obtained from the planning hydrologist. Preliminary geologic investigation reports and reservoir sedimentation design summaries were obtained from the geologist. Drainage areas were measured from USGS topographic maps. A base flow at 5.5 csm was used for each structure. Structure class determinations were based on field examination of each site by the SCS planning engineer, State Conservation Engineer and Design Engineer, and members of the Indiana Department of Natural Resources, Division of Water.

Design of each structure was made utilizing the ADP computer services at Lincoln, Nebraska. Several trial designs were made for each structure using various principal spillway and emergency spillway sizes and elevations. Structures were proportioned by this procedure. Concrete chute principal spillways were necessary on multiple purpose structures 4A and 8 to maximize utilization of available storage for municipal and industrial water supply.

Requirement for 50-year sediment storage as determined by the geologist was utilized to set the elevation of the principal spillway for floodwater retarding Structure No. 28. Elevations of permanent pools for the multiple purpose structures were set in view of limitations on available storage and water yield, easements and the local sponsoring organizations' wishes. Storage for the second 50-year sediment accumulation was provided in the flood pool of floodwater retarding Structure No. 28 and in the flood and permanent pools of multiple purpose reservoirs.

Elevations for vegetated spillways on multiple purpose Structures 4A and 8 were set at the maximum water surface elevation of the emergency spillway hydrograph routings through the principal spillways. Top of dam for these two structures was established at the maximum water surface elevation of the freeboard storm routed through the principal and vegetated spillways.

The firm of Midwestern Engineers, Inc., Loogootee, Indiana, assisted the Whitewater Valley Conservancy District in the development of a regional recreation plan. Individual recreation facilities plans were prepared for Structures No. 38, 35 and 23B and the channel recreation development. Estimates of quantities and costs for the recreational facilities, engineering services, and operation, maintenance, and replacement were included in the plans.

The cost estimates for all structures are based on detailed estimates of quantities. Abstracts of bids for the most recent PL-566 projects contracted in the state were analyzed to determine the unit prices to be used in the cost estimate. These unit prices are consistent with current unit prices used by the Indiana Engineering Design Unit of the Service.

Estimates of alternate costs for single purpose water supply and recreation structures were made for use in the cost allocation procedure.

Values of land and improvement varied greatly from site to site, and were estimated by the local sponsors.

The engineering services and project administration costs are based on a percent of the construction. The annual operation and maintenance costs are based on drawing SCS-3-L-46170 as revised 3-19-65, by the Lincoln E&WP Unit.

Channels

The basic data used for channel designs and cost estimates were field surveys, USGS topographic maps, aerial photographs, geological investigations and field observations. Profiles were prepared from numerous cross sections, valley sections and bridge surveys and were used to determine bank full elevations, grades, and hydraulic gradients of the channels. Capabilities required were based on discharges provided by the planning hydrologist. Side slopes are designed on 2:1 slopes in excavated areas.

The "n" values for the aged channel as well as the as-built channel reflect the type of improvement planned for each channel. The "n" for both aged and as-built are weighted using the method outlined in Supplement B, NEH-5.

The "n" values for the aged channels are .035 to .040 and for the as-built channels are 0.025 to 0.040. The velocities in the aged channels range from 1.4 to 5.6 feet per second and in the as-built channels from 2.2 to 6.1 feet per second. Technical Release No. 25 and field observations were used to determine the maximum allowable velocities for the channels.

The E&WP Unit drainage engineer was consulted on the watershed channel work, and worked with the Planning Staff engineer in development of the type and extent of the works of improvement to be installed. A field trip to the watershed was made May 1970, in response to SCS Engineering Memo No. 72, where on-site field observations of recently constructed channels were noted. The planned works of improvement were discussed with a conclusion by the drainage engineer that the works of improvement should result in a reasonably stable channel.

Maximum as-built allowable velocities by reaches are as follows: Reach A5 - 5.2 ft/sec; Reach A2 - 5.2 ft/sec; Reach D3 - 6.2 ft/sec; and Reach D2 - 6.2 ft/sec.

Quantities estimates were made by the average end area methods. The channel cost estimates are also based upon unit prices determined from abstracts of bids on the most recent PL-566 contracts in Indiana.

Special Land Treatment Measures

A total of 115 special land treatment measure structures were studied in the watershed. Storage available, surface areas, drainage areas and fill yardage were determined from USGS topo maps. Type of principal spillway was determined from the applicable engineering memorandum (Indiana No. 7 and SCS No. 27). Corrugated metal pipe drop inlets were used where permitted; reinforced concrete pipe drop inlets were used elsewhere. A construction cost was determined from the fill yardage, and the type of principal spillway to be used for each structure. A cost per surface acre was then compiled for each structure.

Forty-seven (47) of the structures were determined to be feasible based on watershed needs, storage requirements as per applicable engineering

memorandums, cost per surface acre, and experience with similar structures under the going program. A detailed geology and hydrology study was not made on these structures.

Thirty-three (33) of the structures were considered as having a hazard class "a", and the remainder a hazard class "b".

ECONOMICS

Identification of watershed problems and consideration of effects of proposed improvements provided the basis for evaluation of project benefits. Basic datum was obtained through interviews with watershed residents, Soil Conservation Service employees, and local watershed leaders. Field economic studies and information supplied by other Watershed Planning specialists supplemented basic interview data. Analysis of all project benefits was made through a comparison of "with" and "without project" conditions. Problem areas not affected by proposed project measures were not evaluated unless believed critical to project formulation. All information utilized was reviewed for reasonableness and accuracy.

Floodwater Damage

The principal method used in the evaluation of floodwater damages was the "frequency method" as described in Chapter 3 of the Economics Guide. Identification of the relationship between flood size and resulting flood damages provided the basis for damage determination under this method.

Crop and Pasture. Evaluation of crop and pasture flood damages under the "frequency method" was achieved utilizing standardized crop depth-damage factors as a base. Factors used had been previously developed for evaluation of watershed projects throughout the northern portion of Indiana. Such

factors relate flood depth and month of flood occurrence to expected crop losses. Sufficient interview information was obtained to support applicability of the factors for use in the watershed.

Composite acre, flood depth-damage factors were then developed. Incorporated into these factors were the above mentioned crop damage factors plus data on future floodplain land use, projected crop yields and prices, and monthly probabilities of flood occurrence. Resultant composite acre values served as estimates of expected losses on a representative floodplain acre from various depths of flooding irrespective of the time of year when flooding occurs.

Application of the composite acre factors to acre-frequency information supplied by the planning hydrologist provided the means of determining damage-frequency relationships and subsequently average annual damages with and without the project. Such damages were adjusted to eliminate double counting arising through recurrent flooding in a given year. Basis for the adjustment was a regression analysis of the ratio Y (average annual damages adjusted for recurrent flooding/unadjusted average annual damages) on the ratio R (average annual acres flooded/maximum floodplain acres).

Floodwater damages on a total of 6,230 floodplain acres were evaluated using this method. Damages on only 4,651 acres of this total occur within the zone of influence of those structural measures included in the final plan. Damages on these acres are recorded in Table 5. Routine computations required by the procedure were performed using the Economics II computer program.

Other Agricultural and Non-Agricultural. Damage to other agricultural and non-agricultural property, although significant to the watershed as a

whole, was not sufficiently concentrated in specific areas so as to be a major consideration in formulating structural measures for flood prevention. Reports by local watershed residents, county road officials, and personnel of the Penn-Central Railroad were relied upon in locating and estimating flood damages. Specific attention was focused on gathering information on small floods of a size which might be expected to occur yearly as well as on a large flood of a size approximately a ten year event.

Evaluation was performed using such information as a basis for construction of simple damage-frequency curves. Application of estimated damage reductions to with project damages so determined yielded a measure of project benefits. Judgment was used in screening from the evaluation process those damages which appeared insignificant (less than \$50 average annual) and those on which little or no reduction could be expected through project measures.

Sediment. Sedimentation of the Brookville and Middle Fork reservoirs was evaluated using the "straight-line method" described in Chapter 5 of the Economic Guide. Annual rates of sedimentation were supplied by the planning geologist for future without project condition; future with project condition, land treatment only; and future with project condition, land treatment and structures. Value of the storage lost was determined as the product of annual sediment deposition in acre-feet multiplied by the original cost per acre-foot of storage adjusted to projected prices. Resultant values obtained were \$73.54 per acre-foot on the Brookville Reservoir and \$443.05 per acre-foot on the Middle Fork.

Alternative evaluation procedures to the straight-line method were investigated for possible use on the Middle Fork Reservoir. Contact with the reservoir manager as well as consulting engineers active in municipal water supply work failed to uncover data indicative of a more acceptable method of

evaluation. Particular attention was directed toward obtaining information on expected service loss, reduction in reservoir life, or increased water treatment costs resulting from sediment deposition.

Damages to Whitewater Lake were evaluated as losses in future recreation opportunity. Key to the evaluation was an assumption that all recreation use of the State Park in which the lake is located is either directly or indirectly attributable to the lake itself. Such an assumption was supported by personnel of the Indiana Department of Natural Resources, Division of Parks.

Evaluation was made by projecting a with and without project timetable from which remaining useful life of reservoir segments could be obtained. Basis for preparation of the timetable lay in projections by the planning geologist of future reservoir sedimentation by segments. An average water depth of one foot or less was assumed to represent the point at which a reservoir segment no longer possessed recreation value.

Sediment damages were then determined by associating loss of usable water surface area at various points in time with proportionate reductions in annual recreation visitor day use. Monetary expressions of the lost recreation opportunity were calculated using the lesser of \$1.50 per visitor day (value of the recreation benefit foregone) or the original cost per visitor day of the reservoir and recreation facilities less salvage value adjusted to projected prices. Application of appropriate discount and annuity factors provided the basis for conversion to average annual equivalents.

Information supplied by the Indiana Department of Natural Resources, Division of Parks established a five year average attendance (1964-1968) at Whitewater State Park of 96,837. Lake surface area averaging greater than

one foot in depth during this period was established at 161.9 acres. Annual equivalents of depreciable installation costs for reservoir and facilities plus charges for operations, maintenance and replacement were determined to be \$109,205 per year. Pertinent annual values developed from this information were \$1.13 per visitor day of recreation use (based on costs) and \$674 of recreation value per lake surface acre greater than one foot in depth.

Erosion. Locations and preliminary observations as to the extent of erosion damage in the watershed were provided by the planning geologist. Economic field investigations followed. Due to the apparent impracticability of formulating an effective system of structural measures to treat these problems, no economic evaluation was performed.

Indirect. Indirect damages were evaluated as a percent of direct flood damages. Percentages utilized were 5 percent of agricultural damage, 20 percent of non-agricultural damage, and 10 percent of sediment damage.

More Intensive Use and Drainage Benefits

Agricultural. Flood prevention benefits of the more intensive use type were evaluated jointly with drainage benefits on 125 acres of cropland in Reach A2, 282 acres in Reach A5, and 194 acres in Reach D4. Method of evaluation was the "net income" procedure as described in Chapter 3 of the Economics Guide.

Evaluation was begun with an identification of expected crop yield increases which would result from the project. Information supplied through farmer interview together with judgment of agronomic and soils specialists familiar with the area provided the basis for these determinations.

Gross income increases with project were then computed using projected crop price data. Deduction of increased cash production costs and associated

costs for the installation of on-farm improvements supplied a measure of increased net income to land, labor and management. Resultant net income increases were discounted for lag in accrual in arriving at project benefits. Participation by watershed landowners was assumed complete in the areas evaluated.

Pertinent summary information taken from the evaluation is as follows:

	Dollars		
	(Reach A2)	(Reach A5)	(Reach D4)
Increased Gross Income	3,927	8,787	14,108
Increased Production Costs	1,692	3,630	6,905
Associated Costs	748	2,188	1,577
Increased Net Income	1,487	2,969	5,626

Figures presented reflect full development prior to the application of discount and annuity factors. Discounts applied were limited to benefit values on 112 acres of Reach A2. Allowances made were for initial lags in accrual of up to five years followed by straight-line lags of an additional three to five years for development. Benefits on all other areas were assumed to accrue at full value from the onset of the evaluation period.

Separation of joint flood prevention-drainage improvement benefits was based on the distribution to purpose served of project channel improvement costs. Such division, although a departure from the generally accepted 50-50 split, represented a more reasonable benefit distribution. Benefits as distributed are recorded in Table 6. Other agricultural benefits of the enhancement type were not evaluated due to the impracticality of formulating a more effective project.

Municipal and Industrial Water Supply Benefits

Estimates of benefits to water supply features of Structures 4A and 8 were provided by local sponsors. Identification of need for water supply as well as water quality was presented in a report summarizing public hearings of the Stream Pollution Control Board of the State of Indiana. "Appendix D" of the Ohio River Basin Comprehensive Survey also recognized these problems.

Test for economic justification involved a simple cost comparison per acre-foot of permanent pool storage between the existing water supply reservoir at Richmond, Middle Fork Reservoir, and the proposed multiple purpose structures. Comparison was made on the basis of permanent pool volumes as no specific storage was provided for sediment in the Middle Fork Reservoir. Price base used for comparative purposes was 1969. Structural modifications on the Middle Fork Reservoir planned for the 1970 to 1972 time period were assumed complete. Cost estimates for the planned expansion were obtained from personnel of the Richmond Water Works Corporation. Pertinent data used in the comparison is given below:

	<u>Storage</u> (Acre-Feet)	<u>Cost/Ac. Ft.</u>
Middle Fork Reservoir	6,500	\$522
MP Structure 4A	5,320	126
MP Structure 8	3,556	154

Recreation Benefits

Midwestern Engineers, Inc., a private consulting firm, was commissioned by local watershed sponsors to conduct a study and prepare a report on outdoor recreation needs in the Whitewater Valley Conservancy District. Information

presented in the report provided the background for assessing project recreation benefits. Procedures used in preparation of the report were reviewed and found compatible with those currently employed by the Soil Conservation Service.

Determination of recreation needs as presented in the report began with an assessment of present population in the study area (Conservancy District). Projections of present population together with factors reflecting expected annual per capita participation in a variety of outdoor recreation activities provided estimates of recreation activity demand at various points in time. Planned or existing outdoor recreation facilities in the study area along with recreation "use standards" established that portion of demand which could be fulfilled. Twenty-five percent of the facilities planned for the Brookville Reservoir area were assumed to be available for satisfying recreation demand in the study area. Unsatisfied demand was identified as recreation needs.

Emigration from the study area for purposes of participating in outdoor recreation activity was assumed to equal immigration into the area. No consideration of recreation activity supply or demand originating outside the area was incorporated into the report. Recreation needs identified in the report could therefore be viewed as conservative, as much of the area adjacent the study area is also deficient in available outdoor recreation opportunities.

Estimated activity day use afforded by project recreational developments was computed from use standards. Such standards reflect a level of usage consistent with maintenance of the overall quality of the recreation development. Visitor day use was calculated on the basis of 2.5 activity days per visitor day on those recreational developments offering eight or more types of outdoor

recreation activity and 1.5 activity days per visitor day on those offering less than eight. Annual use determined for Structure 35 recreation development was 173,000 visitor days; for Structure 23B, 19,500; for Structure 38, 41,500; and for the channel recreation development downstream of Richmond, 52,000.

A benefit value of \$1.50 per visitor day was used on all developments. Such a value was believed warranted in view of the overall balance in recreation opportunity which the planned developments would provide.

Recreation benefits of an incidental nature were evaluated to the water supply purpose in Structures 4A and 8. Estimates of anticipated visitor day use were based on Indiana and Ohio data correlating angler day use with surface area. Gross benefits were determined as the product of usable water surface area in acres, 50 annual visitor days of use per acre of water surface, and 50 cents per visitor day.

Annual costs for installing and maintaining minimum sanitary facilities and in providing public access were deducted from gross benefits to each site. A total of 612 acres in Structures 4A and 8 were evaluated.

Secondary Benefits

Secondary benefits accruing locally were evaluated as both "stemming from" and "induced by". Benefits of the "stemming from" type were evaluated at 10 percent of direct primary benefits. "Induced by" benefits were evaluated at 10 percent of increased annual cost within the watershed required in realizing and perpetuating project benefits.

Prices and Interest Rate

Adjusted normalized prices as transmitted by the Inter-departmental Staff Committee of the Water Resources Council in April 1966, served as

the applicable price base for computation of project benefits and operation, maintenance and replacement costs. Estimated construction costs for project installation were based on 1969 prices.

Annual equivalents of installation costs and project benefits were computed using a $5 \frac{3}{8}$ percent interest rate. Private expenditures connected with the installation of on-farm improvements required for the realization of project benefits were converted to annual equivalents using a 6 percent interest rate.

Cost Allocation

Structures. Allocation of costs to purpose on project multiple purpose structures was accomplished utilizing the "alternative justifiable expenditure" method. Such method was felt to furnish a more equitable allocation of costs than the preferred "use of facilities" method.

As the five multiple purpose structures and one single purpose structure included in the plan represented an interdependent grouping for flood prevention, all flood prevention benefits to structures were pooled. Flood prevention benefits to single purpose Structure 28 were drawn from the total on a one to one basis in an amount equal to annual installation costs plus operation, maintenance and replacement charges. Remaining flood prevention benefits were prorated to multiple purpose structures on the basis of drainage area controlled.

Alternate costs for providing benefits in single purpose structures comparable to those accruing to multiple purpose structures were estimated by the planning engineer and the M & I water sponsor. Flood prevention alternate costs were determined to be greater than resulting benefits in each case. Alternate costs for water supply and recreation were found to equal the multiple purpose structure costs.

Costs for land acquired by fee title, excluding acquisition costs, on Structures 35, 23B and 38 were assigned as specific costs to recreation. Flowage easement costs for these structures were assigned as specific costs to flood prevention. Costs for land in the beneficial water use pools of Structures 4A and 8 were assigned as specific costs to water supply. Land in flood retarding pools of these two structures was charged to flood prevention. Increased construction and engineering costs required for "blanketing" Structure 8 for water holding purposes were charged as specific costs to water supply. Remaining installation costs for all structures were considered joint costs.

Channels. Assignment of costs to purpose on project multiple purpose channels was done utilizing the second alternate as described in Chapter 3 of the Watershed Protection Handbook. Such method was believed to supply the more realistic allocation of cost to purpose served. Pertinent data from the allocation is shown below.

	<u>Uncon. D.A. of Channel</u>	<u>Wet Land Ac. in Benefited Area of Channel</u>
Baker Ditch Main & Lat. 1	1,917 ac.	450 ac.
East Fork Main and Lat. 1	24,070 ac.	1,049 ac.
Middle Fork Main & Lat. 1	8,230 ac.	709 ac.

GEOLOGY

Basic data on the geology of the area was obtained from publications of the Indiana Geological Survey and through information given by the Geology Department of Earlham College in Richmond. This was supplemented by on-site geologic inspections of the watershed, and subsurface investigation at one

site (Structure No. 35). Bedrock consist of shales and limestones of the Richmond group, (upper Ordovician) and is overlain by unconsolidated sediments of the Wisconsin glacial stage of Pleistocene age. Alluvial sediments of recent age are present in the floodplain area.

Structures

A preliminary geologic investigation which included field examination of surface features and hand auger borings to determine soil characteristics was conducted at structure sites. Power equipment was used on Structure No. 35, a recreation site. Available geologic maps and reports, aerial photos and topographic maps were utilized in investigation. Form SCS-375 Preliminary Investigation of dam sites, was completed for all structure sites included in the final plan.

Power auger borings were made on the centerline of dam, floodplain and borrow areas of Structure No. 35 in determining the extent of glacial sand and gravel outwash deposits and thickness of the overburden. Bedrock in the floodplain area left of the channel was found to be shallow, with the bedrock profile dropping off steeply on the right side of the channel. Alluvial deposits of clays, sands and gravels were present in the floodplain with water levels near the surface. The abutments of glacial till contained some sand lenses. Adequate borrow material is available from the hillsides and emergency spillway area. With selective placement of the more plastic embankment materials for watertightness, seepage through the dam should be negligible.

Bedrock appears near the channel floor at most of the other structure locations. Physical characteristics of these sites are quite similar.

Such characteristics include glacial till containing sand lenses in abutments and alluvial silts and clays with interspersed sand and gravels in the floodplain. High water tables in floodplain areas require that all borrow material be obtained from adjoining hillsides. Glacial till is the primary material found in these hillsides. There will be little or no rock excavation in emergency spillway areas.

The Upper Ordovician bedrock sequence, including the limestones, is free of extensive development of solution features, cavernous conditions or karst topography. The general absence of these conditions is, in large part, due to the very nature of this rock. It is typically a clayey limestone and thereby less subject to solution; it also is interbedded with essentially impermeable shale which tends to prevent the development of large, interconnected openings and extensive underground drainage systems. In addition, the bedrock is blanketed and protected over much of its outcrop area by relatively impermeable glacial till. Experience with existing reservoirs and foundation exploration for other proposed dams supports the previous discussion. The 277 acre Middle Fork Reservoir dam near Richmond (and five miles west of proposed Structure 38) is founded on bedrock belonging to this Upper Ordovician sequence. The 199 acre Whitewater Lake, located about five miles southwest of proposed Structure 23B, involves this same bedrock sequence overlain by glacial materials. Neither of these reservoirs has experienced seepage or stability problems with respect to the bedrock. The limited rock coring conducted at proposed Structure 35 revealed a clayey limestone and shale. Core recovery rates were high and no loss of circulation of the drilling fluid was experienced. Extensive investigations at the U. S. Army Corps of Engineers Brookville Reservoir (under construction)

located at the extreme southern tip of the watershed did not indicate unusually severe seepage or water loss problems in the bedrock. Investigations of limestone bedrock has been made in the Upper Vernon Forks Watershed, located approximately 30 miles to the southwest. This study found the Upper Ordovician sequence of limestone and shale, where subjected to rock coring, water pressure and water flow tests, to be essentially impermeable.

A few of the special land treatment measures were investigated. As most of these are located at higher elevations, construction was found to be possible from glacial till within the permanent pool areas. A few will be located on shallow bedrock with the borrow coming from higher areas.

Investigations to date indicate that the proposed sites are not underlain by cavernous limestone, the foundations are geologically sound, and the water holding ability of the proposed recreation sites is adequate. However, detailed subsurface investigations will be required at each of the proposed structures for verification of the subsurface conditions and for collection of additional data prior to final design and construction.

Sediment Storage Requirements

The sediment storage requirements for each structure site were calculated according to SCS Engineering Memorandum No. 16 and SCS Technical Release No. 12 using land use data furnished by local SCS technicians.

Sediment deposition at each structure was determined by the volume eroded from sediment sources and delivered to the site. Soil losses were calculated by the "soil decline" equation developed by Musgrave and Associates, and the Universal Soil Loss Equation. Delivery ratios were estimated and applied according to topography (stream density, channel gradients and size, length and percent of slope), watershed slope, and sediment texture.

Channels

Preliminary channel investigations consisted of hand auger and soil sampler borings to determine soil conditions of the channel banks and stream bed and probings to locate bedrock. From these investigations channels and ditch materials were determined. Mostly fine grained soils of alluvium and glacial till were found consisting of silty and sandy, moderately cohesive clays, with some silty and clayey sand zones and silts and an occasional gravel streak. Some sand and gravel bars are present in the stream beds.

Soils on the new ditch excavation proposed on East Fork Lateral No. 1 consist of one to three feet of muck and peat underlain by gray calcareous silts and silty and gravelly clays with some thin sand and gravel zones.

Power equipment will be required during detailed geologic investigation to collect samples for laboratory analysis.

Observations of the channel banks and soil materials revealed that after construction and reseeding there would be rapid recovery of vegetation which should ensure bank stability for the designed allowable velocities as per Technical Release No. 25. Most soil materials are estimated to be moderately plastic. On-site verification of these conclusions was made by the Service Drainage Engineer from the Lincoln Regional Technical Service Center.

Erosion and Sedimentation

Aerial photographs were used to locate bottomland damage areas, critical upland erosion areas, and other visible points of significant erosion in the watershed. Locations obtained were investigated in the field. Local farmers

were interviewed in determining effects of such erosion on agricultural production. Historical information pertinent to projecting future erosion damage was also obtained at such time.

Preliminary borings were made along a few selected ranges on main stem floodplain areas downstream of Richmond and on major tributaries to the main stem in Union County. Impracticality of developing a flood prevention structural program effective in achieving significant reductions in erosion damages in the watershed precluded the need for detailed geologic land damage investigations.

Sedimentation of Middle Fork and Brookville Reservoirs and of Whitewater Lake were determined using gross erosion data together with findings from reservoir sediment surveys. Comparison of measured sediment deposition in Whitewater Lake and Middle Fork Reservoir to gross erosion from their respective drainage areas, provided estimates of delivery ratios. Information supplied to the planning economist included projected sediment deposition for future conditions without project; future conditions with project, land treatment only; and future conditions with project, land treatment and structures. Sedimentation projections for future without project conditions were developed under the assumption that the going land treatment program would achieve the same overall dimension as the planned accelerated program, but would do so gradually over a twenty-five year period.

Projections of future sediment deposition patterns within Whitewater Lake were developed and supplied to the planning economist. Historical sedimentation rates by reservoir segments, available through the 1963 reservoir survey, provided the basis for the projections. Modification of

these rates was required to reflect expected reductions in future sedimentation occurring as a result of planned land treatment and structural installations. Deposition within a given reservoir segment was assumed to continue in the same relative proportions to total delivered sediment as that which occurred in the past. At such time that deposition within a given segment was determined to reduce average water depth of that segment to one foot or less, it was assumed that most sediment normally deposited there would be channeled to the next segment.

FORESTRY

Information on the hydrologic condition of the forest land in the watershed and the reasons for the present hydrologic condition were obtained in a series of systematically selected field plots. This information was the basis for developing the forestry program and the precipitation-runoff curve numbers for the forest land. The data obtained included measurements of the litter and humus layers, determination of soil type, and other hydrologic factors. It also included recording the presence or absence of disturbance factors such as fire, grazing, cutting, logging and the abnormal infestation of insects or disease which might adversely affect hydrologic condition or increase fire hazard.

Adequate forest fire protection is provided in Indiana by the Indiana Department of Natural Resources, Division of Forestry, cooperating with the U. S. Forest Service through the Clarke-McNary Cooperative Fire Control Program. The Ohio portion of the watershed is outside the State's forest fire protection zone. Adequate forest fire protection is provided for this area by the local fire departments. There were no recorded forest fires in the

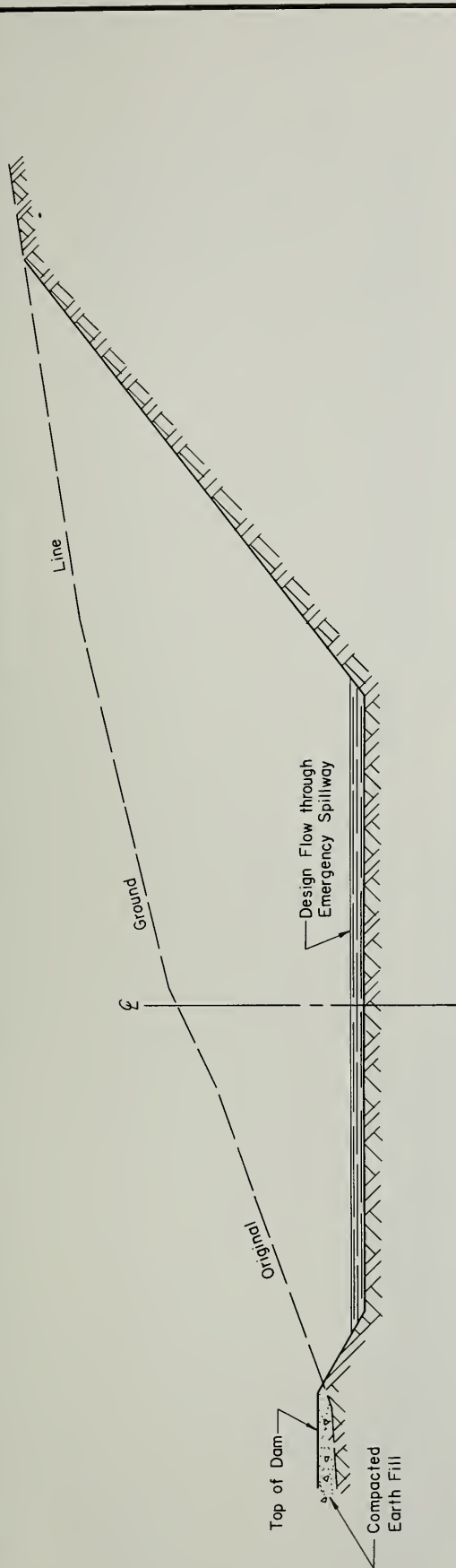
watershed during the past five years. Fire loss index goals for the State and the watershed are 0.1 percent. No appreciable increase is anticipated in fire occurrence or area burned as a result of construction activities, tree planting, cultural operations, or increased recreational use. Adequacy of protection is under continuous review by the respective state forestry organizations.

BIOLOGY

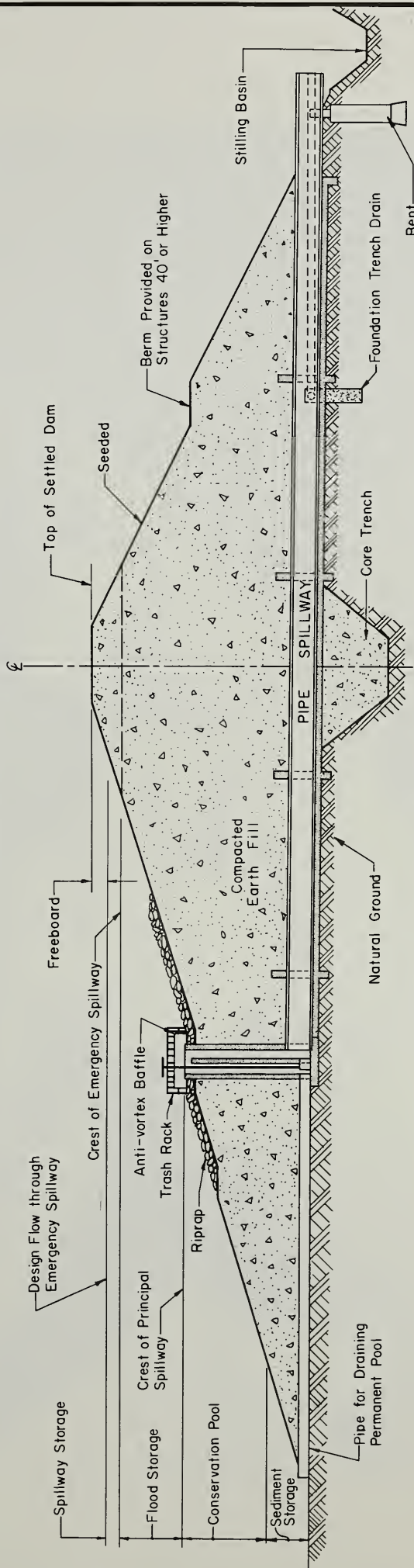
The biology aspect of this watershed was reviewed by biologists from the Indiana Department of Natural Resources, Division of Fish and Wildlife, the Bureau of Sport Fisheries and Wildlife, and the Soil Conservation Service.

Numerous field studies have been made in and near this watershed. Fish sampling studies, Rural Letter Carriers Game Surveys, wood duck breeding ground surveys, spring crowing counts, and sportsmen questionnaires have been made and utilized in this report. Research information has been supplied by the Indiana Department of Natural Resources and the Indiana University Stream Survey Studies.

Further field studies and analyses were made by canoe and field observations by Soil Conservation Service engineers, biologist and soil conservationists, and the Indiana Division of Fish and Wildlife fisheries biologist. Recommendations related to project measures were contained in a report by the Bureau of Sport Fisheries and Wildlife. These recommendations were reviewed with the Sponsoring Local Organizations by representatives of the Soil Conservation Service, Indiana and Ohio Departments of Natural Resources, and the Bureau of Sport Fisheries and Wildlife. The recommendations agreed upon by the sponsors are contained in the body of this work plan under the various appropriate sections.

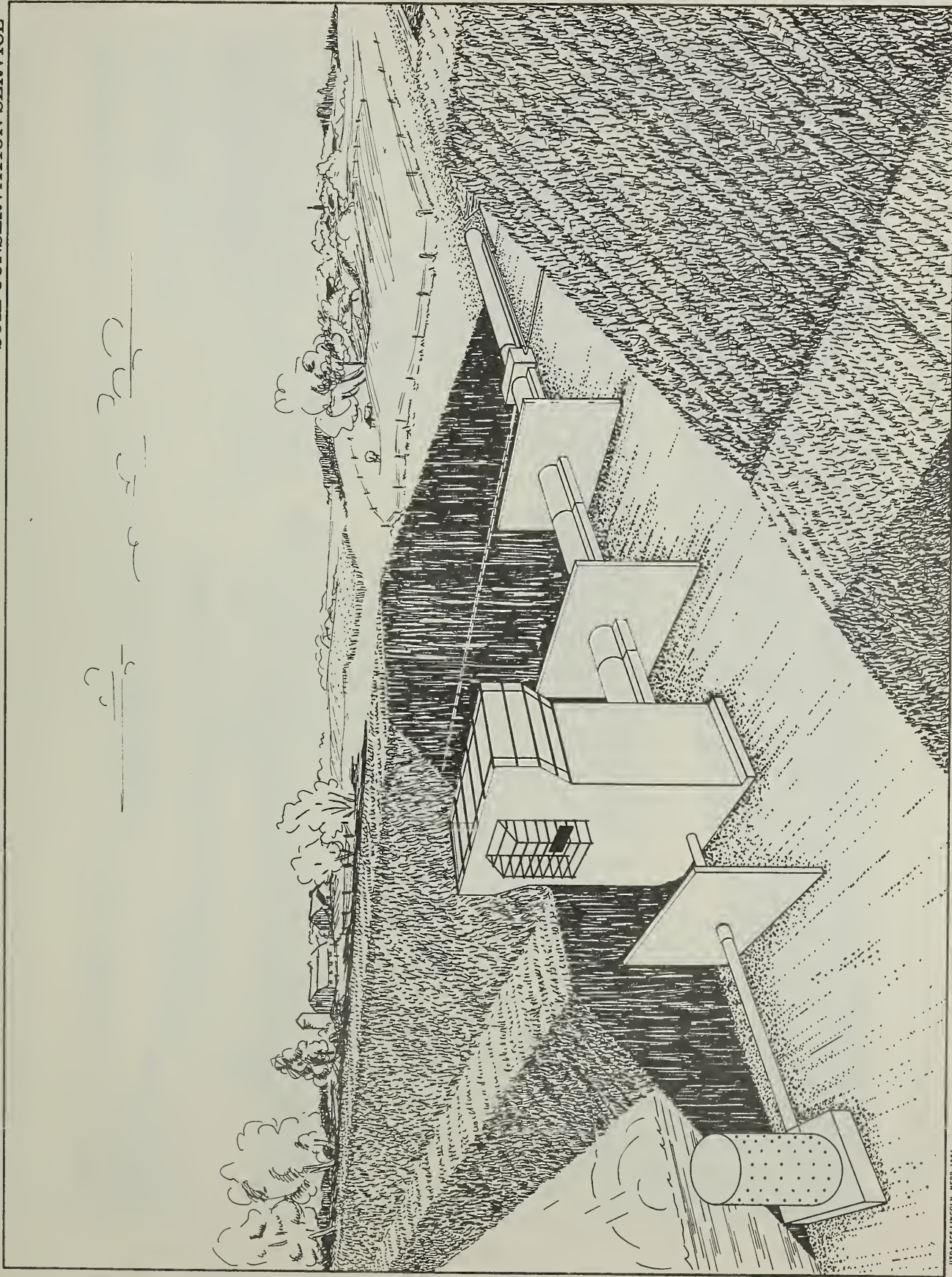


CROSS SECTION OF EMERGENCY SPILLWAY
CONTROL SECTION



CROSS SECTION OF TYPICAL MULTIPLE PURPOSE STRUCTURE
ALONG PRINCIPAL SPILLWAY

Figure 1

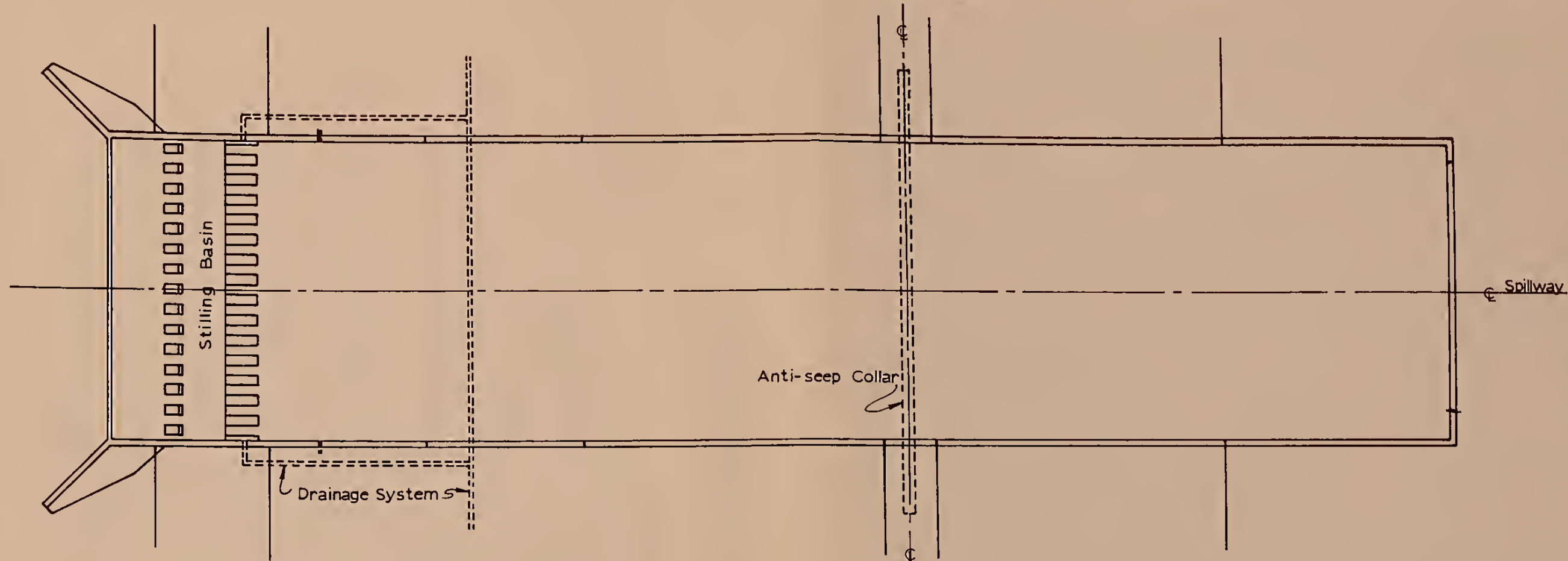


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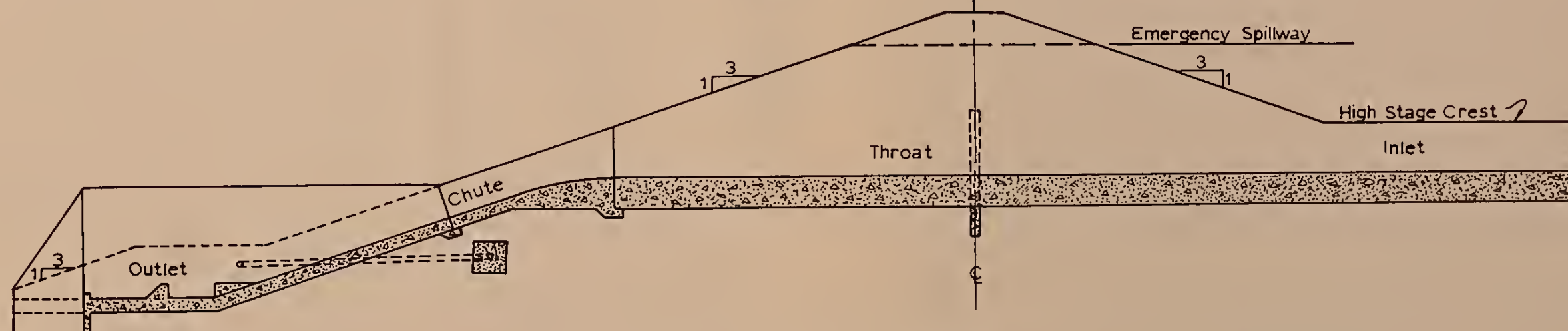
5, 0-20, 698

Reinforced concrete pipe drop inlet with drawdown





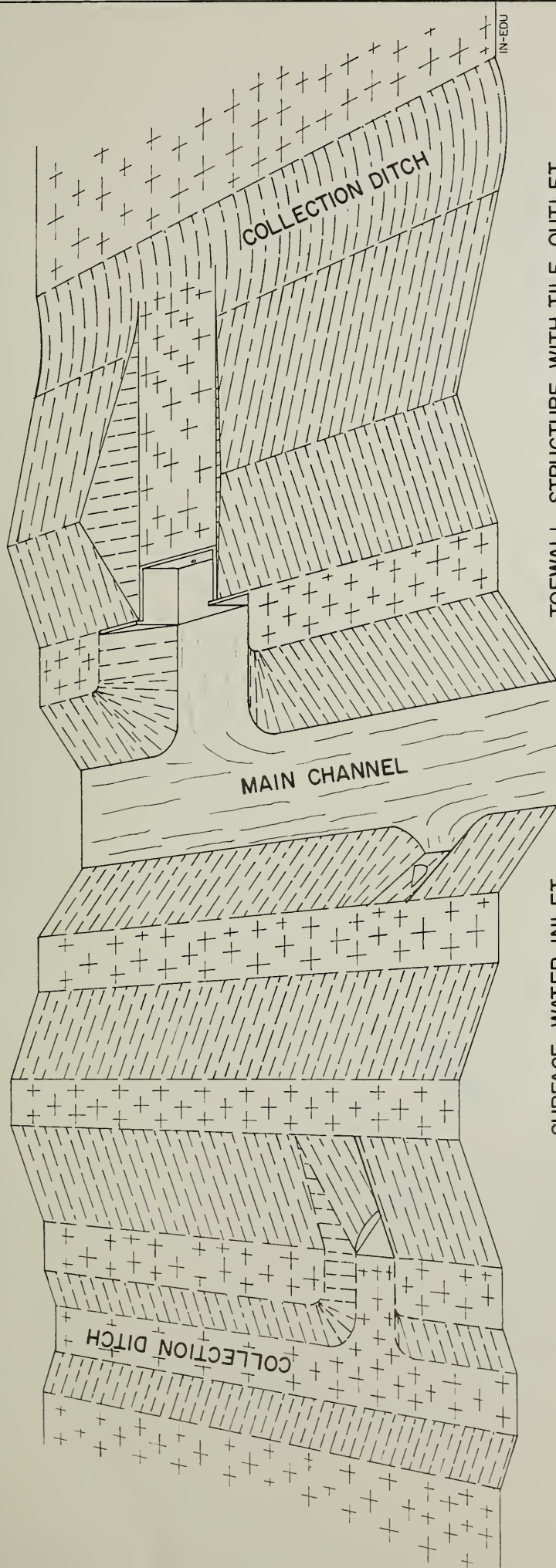
PLAN



SECTION ON CENTERLINE

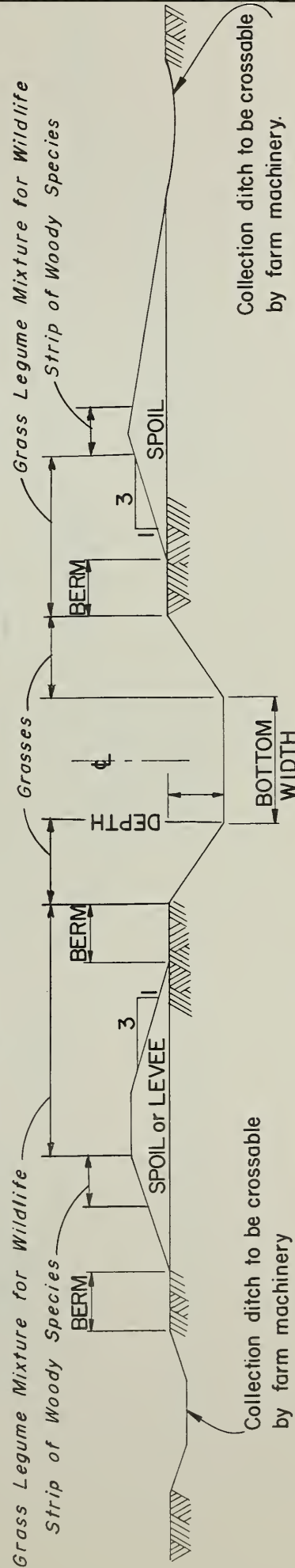
TYPICAL STRUCTURE LAYOUT
REINFORCED CONCRETE BOX INLET CHUTE
SPILLWAY

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE



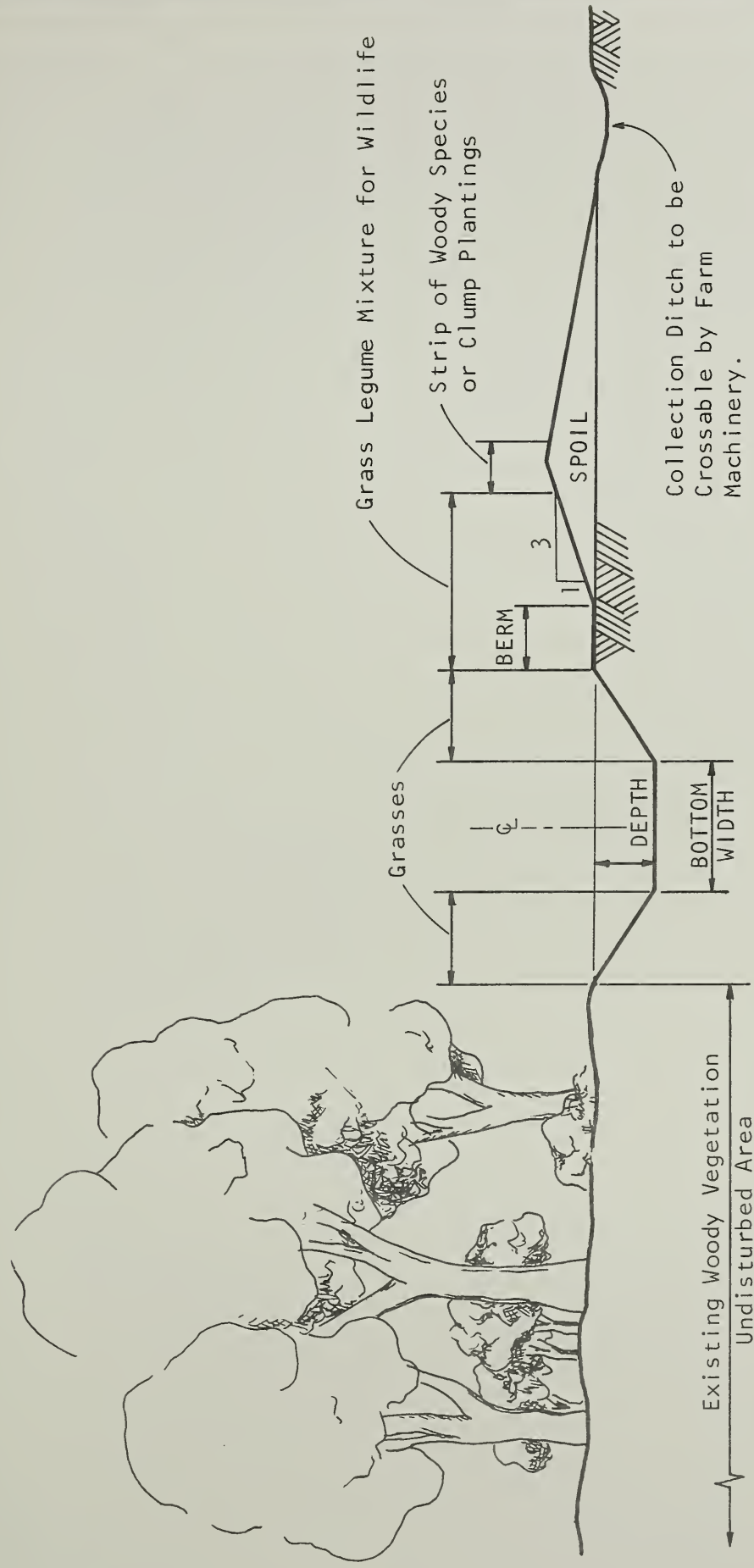
SURFACE WATER INLET

TOEWALL STRUCTURE WITH TILE OUTLET



TYPICAL CHANNEL CROSS-SECTION

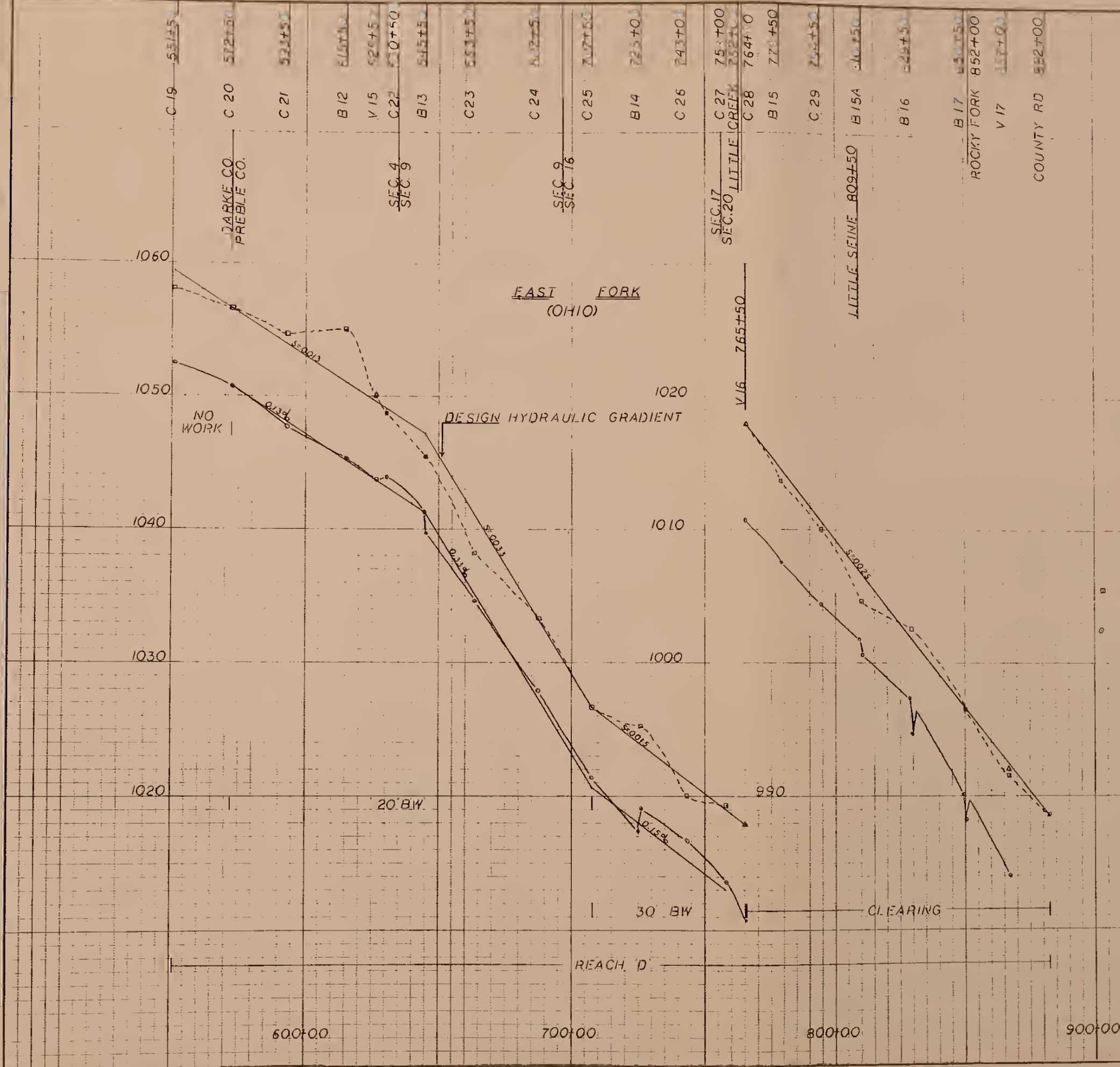
SHOWING REESTABLISHMENT OF VEGETATIVE COVER



TYPICAL CHANNEL CROSS-SECTION

SHOWING VEGETATION TO BE ESTABLISHED AND
THE USE OF EXISTING WOODY VEGETATION FOR
EROSION CONTROL, WILDLIFE AND BEAUTIFICATION





EAST FORK OF WHITEWATER RIVER WATER SHED

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	Date	Approved By
Drawn		Title
Typed		Title
Checked	Sheet No. 2 of 2	Drawing No.



DARKE COUNTY

NE 1/4 SECTION 23

JUNCTION LATERAL-1

EAST FORK
(OHIO)

TWP SEC LINE

TWP SEC LINE

TWP SEC LINE

CENTER TWP SEC 28

□ LOW BANK
• THALWEG

200+00

300+00

EAST FORK OF WHITEWATER
RIVER WATERSHED

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by	Date	Approved by
Drawn		Title
Typed		Sheet
Checked		Drawing No

NO WORK

CONSTRUCT STRUCTURE NW CORNER TWP SEC 7
MADISON-COLETOWN ROAD
NE CORNER TWP SEC 13

LATERAL NO. 1
(OHIO)

STEPHENS ROAD

MILLS ROAD

RUSH ROAD

TWP SEC LINE

TWP SEC LINE

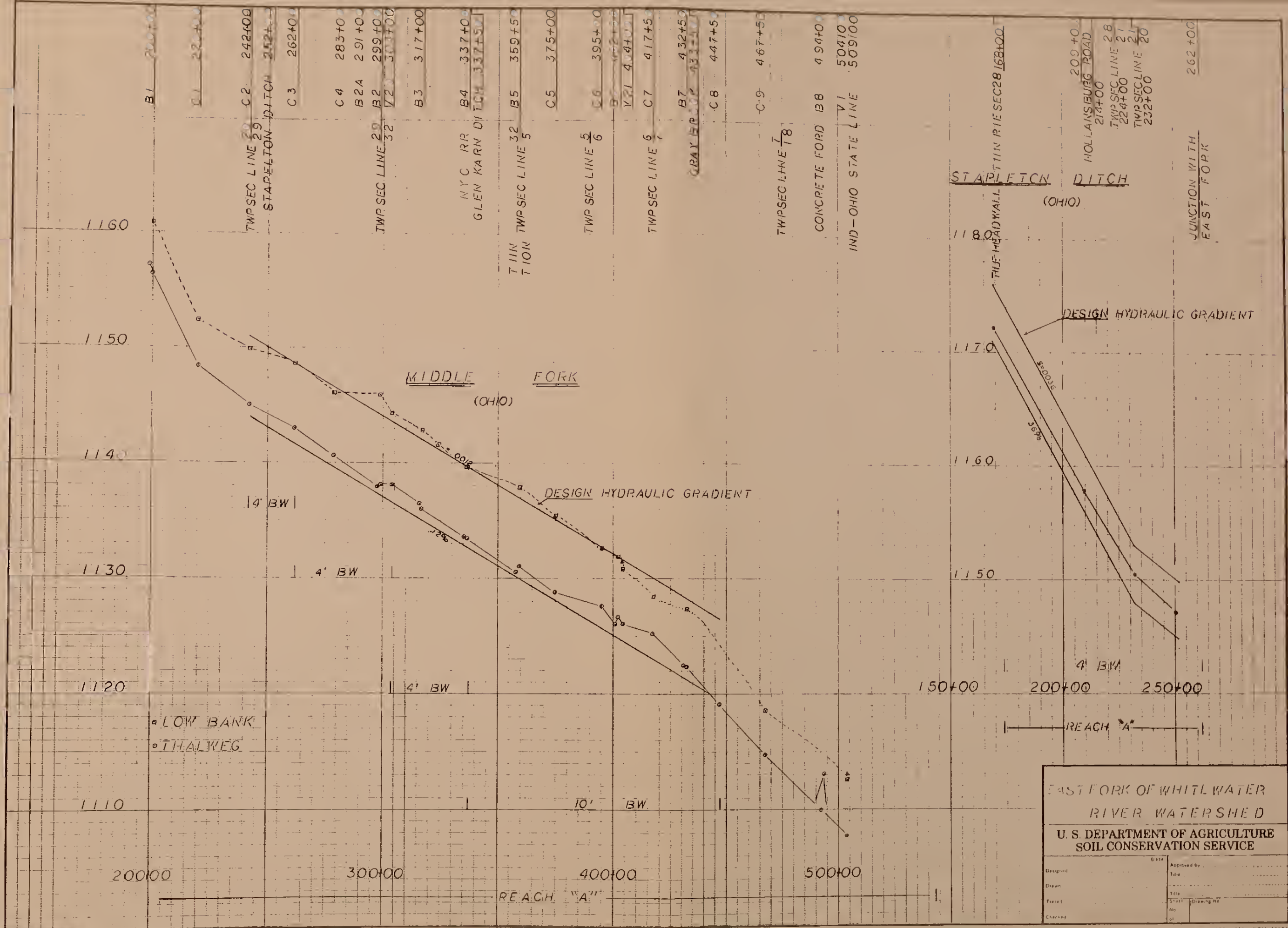
PENNSYLVANIA R. R. BRIDGE

JUNCTION WITH EAST FORK

DESIGN HYDRAULIC GRADIENT

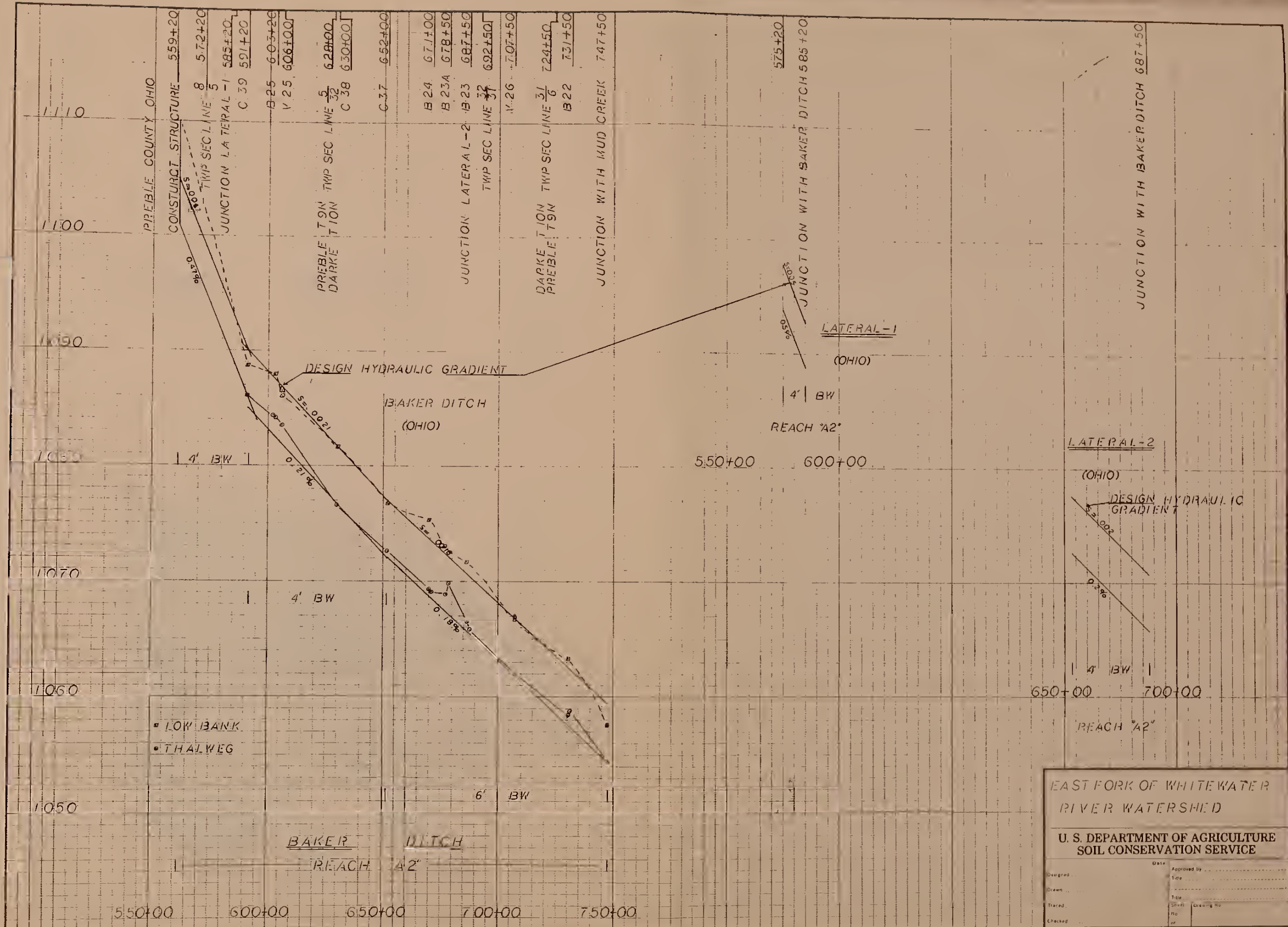
REACH 'D'





EAST FORK OF WHITL WATER RIVER WATERSHED	
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
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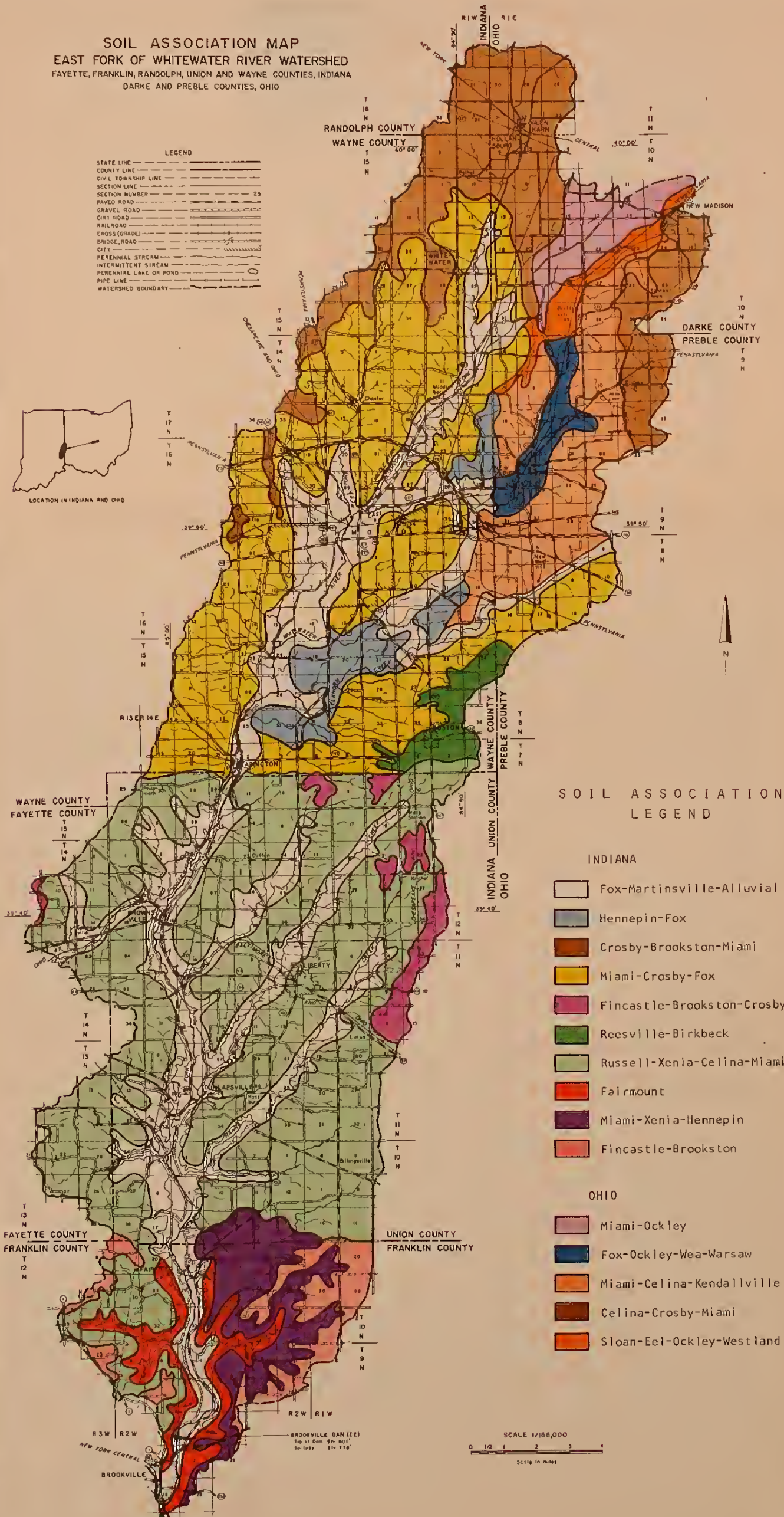






SOIL ASSOCIATION MAP
EAST FORK OF WHITEWATER RIVER WATERSHED
FAYETTE, FRANKLIN, RANDOLPH, UNION AND WAYNE COUNTIES, INDIANA
DARKE AND PREBLE COUNTIES, OHIO

- LEGEND
- STATE LINE
 - COUNTY LINE
 - CIVIL TOWNSHIP LINE
 - SECTION LINE
 - SECTION NUMBER
 - PAVED ROAD
 - GRAVEL ROAD
 - DIRT ROAD
 - RAILROAD
 - CROSS (GRADE)
 - BRIDGE, ROAD
 - CITY
 - PERENNIAL STREAM
 - INTERMITTENT STREAM
 - PERENNIAL LAKE OR POND
 - PIPE LINE
 - WATERSHED BOUNDARY



SOIL ASSOCIATION
LEGEND

- INDIANA
- Fox-Martinsville-Alluvial
 - Hennepin-Fox
 - Crosby-Brookston-Miami
 - Miami-Crosby-Fox
 - Fincastle-Brookston-Crosby
 - Reesville-Birkbeck
 - Russell-Xenia-Celina-Miami
 - Fairmount
 - Miami-Xenia-Hennepin
 - Fincastle-Brookston
- OHIO
- Miami-Ockley
 - Fox-Ockley-Wea-Warsaw
 - Miami-Celina-Kendallville
 - Celina-Crosby-Miami
 - Sloan-Eel-Ockley-Westland

Source: S.C.S. Drawing S-8-23, 15 and information furnished by Field Technicians



LIBERTY 1 MILE

27

30
31

EAST FORK OF WHITEWATER RIVER WATERSHED

UNION COUNTY, INDIANA

SILVER CREEK PARK

STRUCTURE NO. 23B

RECREATION DEVELOPMENT

R-1-W

DAM AND SPILLWAY
20 ACRES

PROPOSED BOUNDARY

RECREATION POOL ELEVATION 981
SURFACE AREA 113 ACRESFLOOD POOL ELEVATION 992.2
FLOOD POOL AREA 178 ACRESNATURE AND
WILDLIFE AREAFLOOD POOL AND LAKE
ACCESS 127 ACRES

LEGEND

- ① SHELTER HOUSE
- ② VAULT TOILET
- ③ BOAT RAMP
- ④ MOORING POSTS
- ⑤ FISHING PIER FOR HANDICAPPED

PARK	180 ACRES
LAKE	113 ACRES
OTHER	147 ACRES
TOTAL	440 ACRES

KITCHEL ROAD

PARK BOUNDARY

STOUT ROAD

COUNTY HOME

INDIANA

SCALE 1/9,000

SCALE 500 0 500 1000 FEET

N 12

POPULATION CENTERS WITHIN 75 MILE RADIUS
SCALE 20 0 20 40 MILES

SOURCE:
BASE INFORMATION FURNISHED
BY FIELD TECHNICIANS

USDI-SCS-UP-CDL WBR 1810

6-10-70

5,P-28,287





LEGEND

- ① PARK SUPERINTENDENT'S RESIDENCE
- ② CAMPGROUND SUPERINTENDENT
- ③ SHOWER BUILDING
- ④ TOILETS
- ⑤ BOAT HOUSE
- ⑥ BATH HOUSE
- ⑦ SHELTER HOUSE
- ⑧ SHELTER HOUSE WITH REST ROOMS
- ⑨ SAND BEACH
- ⑩ SOD BEACH
- ⑪ DIVING TOWER
- ⑫ SANITARY DUMPING STATION
- ⑬ BOAT RAMP
- ⑭ BOAT DOCKS
- ⑮ EXCURSION BOAT DOCK
- ⑯ VAULT TOILET
- ⑰ RENTAL COTTAGES
- ⑱ FISHING PIER FOR HANDICAPPED

**EAST FORK OF WHITEWATER
RIVER WATERSHED
WAYNE COUNTY, INDIANA
ELKHORN PARK
STRUCTURE NO. 35
RECREATION DEVELOPMENT**



SOURCE:
BASE INFORMATION FURNISHED
BY FIELD TECHNICIANS

SCALE 800' 0' 800' 1600' FEET
SCALE 1/16,000

PARK 637 ACRES
LAKE 474 ACRES
OTHER 283 ACRES
TOTAL 1400 ACRES



HAWLEY MILLS ROAD

R-1-E

12

2

PLAYGROUND

PROPERTY LINE

RECREATION POOL
ELEV. 1110.5SURFACE AREA
32 ACRES20/21
29/28 TRAIL 2 MILESFLOOD POOL
ELEV. 1114.5DAM AND
SPILLWAY
10 ACRES

NEW PARIS

GETTYSBURG

ROAD

← NEW PARIS, OHIO

SCALE 500 0 500 1000 FEET
SCALE 1/6,000POPULATION CENTERS WITHIN 75 MILE RADIUS
SCALE 0 20 40 MILES

EAST FORK OF
WHITEWATER RIVER WATERSHED
PREBLE COUNTY, OHIO
NEW PARIS PARK
STRUCTURE NO. 38
RECREATION DEVELOPMENT

LEGEND

- 1 SHOWER BUILDING
- 2 TOILETS
- 3 BATH HOUSE
- 4 SHELTER HOUSE WITH REST ROOMS
- 5 SAND BEACH
- 6 SOD BEACH
- 7 DIVING TOWER
- 8 SANITARY DUMPING STATION
- 9 BOAT RAMP
- 10 BOAT DOCKS - RENTAL SPACES
- 11 BOAT DOCKS - RENTAL BOATS
- 12 ENTRANCE SIGN

PARK	60 ACRES
LAKE	32 ACRES
OTHER	33 ACRES
TOTAL	125 ACRES

SOURCE:
BASE INFORMATION FURNISHED
BY FIELD TECHNICIANS



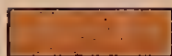


SOURCE:
BASE INFORMATION FURNISHED
BY FIELD TECHNICIANS

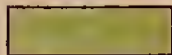


LEGEND

PARK AND STREAM ACCESS



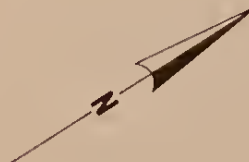
WILDLIFE SANCTUARIES



PROPOSED BOUNDARY



HORSEBACK RIDING AND HIKING TRAIL



SCALE 2000 0 2000 4000 FEET
SCALE 1/24,000

EAST FORK OF WHITEWATER RIVER WATERSHED UNION AND WAYNE COUNTIES, INDIANA RIVERSIDE GREENSTRIP



SOURCE:
BASE INFORMATION FURNISHED
BY FIELD TECHNICIANS

USDA SCS-LINCOLN, NEBR 1970

SHEET 2 OF 2

6-12-70
5,0-28,291

PROJECT MAP
EAST FORK OF WHITEWATER RIVER WATERSHED
FAYETTE, FRANKLIN, RANDOLPH, UNION AND WAYNE COUNTIES, INDIANA
DARKE AND PREBLE COUNTIES, OHIO

